Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. 60. NEW YORK, SATURDAY, JULY 20, 1912. No. 3.

PUBLISHED WEEKLY BY

McGraw Publishing Company

JAMES H. McGRAW, Pres. C. E. WHITTLESEY, Sec'y and Treas.

239 West 39th Street, New York

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

CHICAGO OFFICE.....Old Colony Building
PHILADELPHIA OFFICE.....Real Estate Trust Building
CLEVELAND OFFICE.....Schofield Building
LONDON OFFICE.....Hastings House, Norfolk St., Strand

TERMS OF SUBSCRIPTION.

Subscription price in United States, Cuba and Mexico, $3 per year. Canada, $4.50; elsewhere, $6. Foreign subscriptions may be sent to the London Office.

Requests for changes of address should give the *old* as well as the new address. Date on wrapper indicates the month at the end of which subscription expires.

NOTICE TO ADVERTISERS.

Changes in advertisements should reach the New York office ten days in advance of the date of issue. New advertisements are received up to Wednesday noon of the week of issue.

Copyright, 1912, by McGRAW PUBLISHING COMPANY.
Entered at the New York Post Office as Second Class Mail Matter.

The circulation of Electrical World for 1911 *was* 965,500. *Of this issue* 17,000 *copies are printed.*

NEW YORK, SATURDAY, JULY 20, 1912.

CONTENTS.

Editorials 129
Convention of the National Electrical Contractors' Association..... 132
Congress of the International Association for Testing Materials..... 132
Probable Electrification of Illinois Central Suburban Service..... 132
Opening of New Northern Station, Commonwealth Edison Company, Chicago 132
Boston Convention of the S. P. E. E..... 133
Results of Seven Years' Operation of the Seattle Municipal Plant.. 135
California Public Utilities Act..... 136
California Decision in the Pacific Gas and Electric Case..... 136
Public Service Commission News..... 138
Current News and Notes 140
Electricity Supply in Watcom, Wash..... 141
Increase in Boiler Economy Through Novel Baffling..... 146
Synchronous Motor Performance. By Nicholas Stahl..... 147
Modern Three-Wire Direct-Current Generators. By C. L. Pilger, Jr. 150
Reconstruction of Colorado Central Station..... 150
Frontage Charges in Ornamental Street Lighting..... 151
A Dull-Season House-Wiring Campaign..... 151
Electricity in Gold Refineries 151
Electric Farm Exhibit..... 152
Houston's Downtown Magnetite Arc Lighting..... 153
A Photographic Method for Obtaining Candle-Power Distribution Curves. By Herbert E. Ives and M. Luckiesh..... 153

LETTERS TO THE EDITORS:
The Candle-Per-Watt Meter. By Wilfred T. Birdsall..... 157
Improper Watt-Hour Meter Connections. By Prof. Dr. F. Niethammer 157
Digest of Current Electrical Literature..... 158
Book Reviews 161
New Apparatus and Appliances..... 162
Industrial and Financial News..... 167
Weekly Record of Electrical Patents..... 178

AN EXAMPLE OF WESTERN ENTERPRISE.

An admirable example of the Pacific Coast method of obtaining results is found in the system supplying energy to Bellingham, Washington and vicinity, described in this issue. Bellingham, the northernmost city of any size on Puget Sound, has a population of only some 25,000, but it is as well supplied with electrical energy as most cities of much larger resources. The electrical supply is derived from three plants, which should give as good continuity of service as any city could ask for. One of these is a modern steam plant using oil for fuel and having as its main unit a 2000-kw turbine. A second source is the system of the Western Canada Power Company, from which energy is received at the international boundary, 18 miles from Bellingham. The third is a hydroelectric plant at Nooksack Falls, 42 miles away. It is to the last named that we direct especial attention as a capital example of the simple, economical and efficient small transmission systems which have done so much for the development of the Coast States.

This development is located in one of the national forest reserves on the north side of Mount Baker, and the point chosen for the plant is at Nooksack Falls, where there is a natural drop of 110 ft. As in many such cases, the dam is not of imposing dimensions. In this instance it consists, in fact, of merely a single good log 4 ft. in diameter, anchored to the rocky banks by concrete piers, sheathed and cribbed with loose rock. This is placed about 80 ft. above the crest of the falls and deflects the water into an intake cut out of solid rock and provided with concrete walls to hold the gates in place. The gates are protected from débris by a simple and substantial grid made from 56-lb. T-rails. The forebay is a rock tunnel 260 ft. long connected with the power house by two penstocks, one of them of wood staves with steel elbows at the curves, the other of the ordinary steel-riveted pipe. These drop 176 ft. on a fairly uniform grade into the power plant, which has three walls of concrete and the fourth of corrugated iron.

The plant is not in the least pretentious, but is thoroughly businesslike. Its present equipment consists of one 1500-kw, 60-cycle, three-phase generator, driven by a Pelton wheel with six runners, operating at 200 r.p.m. The transformer house of concrete is on the hillside 150 ft. above the power house and from this runs the pole line to Bellingham carrying a 60,000-volt transmission circuit. This is constructed of heavy cedar poles about 45 ft. in length, set 150 ft. apart, on which are strung the three No. 1 equivalent transmission cables of seven-strand aluminum, and the telephone line below. A few taps are taken off the system for small places along the line and the remainder of the energy is delivered at the substation at Bellingham. A successful plant must be judged by its results and if these can be

obtained with that economy of construction which keeps down the fixed charges and lowers the price of energy so much the better. To tell the truth, it is rather refreshing to describe a thoroughly workable plant free from the somewhat unnecessary expense of construction and equipment that characterizes many recent installations.

CALIFORNIA PUBLIC UTILITIES DECISION.

Underlying the modern theory of public utility regulation is the cardinal principle of justice that in return for taking away the right to earn more than a reasonable return on the fair value of the property used and useful in serving the public, the full measure of net earnings up to such reasonable return, assuming efficient management and operation, should invariably be permitted. Or stating the case differently, the loss of the right to enjoy speculative or excessive profits should be compensated by insurance against the shrinkage of profits below a reasonable amount. Furthermore, the modern theory recognizes that one utility company can more economically serve a given community, if the latter be not too large, than two or more like companies with their respective and independent systems. It is better, therefore, to protect a utility against competition so long as it adequately serves its public at fair rates and with considerate treatment. This is consistent, moreover, with the obligation the public owes to the pioneer utility companies which developed the field and shouldered the risks in the early days when success was a very doubtful matter. The method by which existing utilities are protected, under state public service laws, from needless or wasteful competition, is found in the now familiar certificate of public convenience and necessity. Unless such a certificate is granted by the commission having jurisdiction, after due hearing at which it shall appear that public convenience and necessity require competition, no newcomer may compete with a utility company already in the field. It is now customary to require such a certificate in the case of every new utility company, or every extension by an existing company into new territory, even though the new district has not previously been served.

The California Railroad Commission has recently filed its first important decision in a case involving an application for a certificate of public convenience and necessity, as chronicled elsewhere in this issue. A perusal of the decision quickly discloses its unusual and radical character in respect to the grounds and conditions upon which such a certificate may be issued. The Great Western Power Company was the applicant for certificates granting it the right to compete with the Pacific Gas and Electric Company and five other companies, in major portions of four counties. The commission concluded that the larger portion of the territory in question was inadequately served and presented opportunities for substantial development in the sale of electrical energy, which constituted reasonable grounds, in the commission's judgment, for permitting the applicant company to enter and compete with others in the field. The doors were not indiscriminately thrown wide, however, for a number of companies already in the field, which filed demurrers, were held to be adequately serving their communities and thus entitled to protection. But in a number of municipalities the service of the Pacific Gas and Electric Company was held to be neither complete nor adequate and the rates charged, except under the stress of impending competition, were found to be higher than should have been maintained.

The radical character of this decision, viewed from the standpoint of precedents created by older commissions, lies in the summary enforcement of competition without first demanding that the companies already in the field, regardless of past misbehavior, if any, fulfill their public obligations. This is contrary in principle to important precedents established in Wisconsin, New York and other states, and moreover violates the spirit of fair play. The treatment finally accorded an offending or delinquent utility company might conceivably be the same under either course of procedure, but the method followed in this case smacks of injustice. The hasty enforcement of competition, even in a country but little developed, may not ultimately react for the best interests of all concerned, and the ever-threatening possibility of competition is likely to make capital wary of investing under such circumstances. If the service now furnished a community is inadequate, or inefficient, a remedy lies at hand in the provisions of the law, whereby the offender may be compelled to correct the deficiencies, or suffer the consequences. If rates are unreasonable or discriminatory, the commission may commence investigation under its own motion and order lawful rates which yield no more than a fair return. It would seem more conservative to exhaust these methods, before resorting to competition with its possible duplication and economic waste, than to adopt a disciplinary attitude in the first instance with a possible train of consequences which might result finally in substituting new evils for the old. And furthermore, it seems fairly obvious that the framers of the law intended the more conservative of these two policies to be the guiding rule.

FISCAL REPORT OF SEATTLE MUNICIPAL PLANT.

The municipal ownership and operation of public utilities presents numerous problems of both a civic and an economic character, whose different phases are not readily isolated for individual study. One of the first obstacles often encountered—one might almost say invariably—is the lack of a modern system of accounting which reveals the true state of affairs either as to the actual cost of the plant or the true amount of the net earnings. Another difficult side to the problem is the question of management and its relative efficiency, which touches the human and civic elements that vary in such a marked degree in different instances. If municipal ownership could be studied from the standpoint purely of its economic advantages or disadvantages, much would be gained, but local politics is nearly always a factor which has an important bearing.

In the case of the Seattle, Wash., municipal plant, the last annual report of which is abstracted elsewhere in the present issue, an unusual opportunity is presented for studying the results of municipal operation under circum-

stances of the more favorable sort. The accounts appear to have been kept in very fair shape, and both the statement of revenue and expense and the balance sheet are presented in much detail. The plant itself was described in our June 1 issue, so that both the physical and the financial aspects of this case are available for long-range study. In noting the relatively low commercial rates, it should of course be kept in mind that the energy is obtained mainly from water power. For the calendar year of 1911 the surplus earnings equalled 4.6 per cent on the average investment in plant during the year. The allowance for depreciation, on the same plant investment, was 4.8 per cent, which seems adequate. In comparing the results obtained in this system with the operations of public utility companies, it may be noted that no taxes are paid. The average revenue per kw-hr., for the year, was 3.5 cents. Students of municipal operation will find in this case an unusual opportunity for careful study of the problem.

PHOTOGRAPHIC RECORD OF CANDLE-POWER DISTRIBUTION.

In order that the eye may serve as an instantaneous observing instrument it is necessary that it should be sensibly devoid of registration power. The human eye possesses powers of integration and registration to a very slight extent, as witness the phenomena of the stroboscope, but in about one-tenth of a second the record of any visual stimulus is ordinarily wiped out, and the memory must then be depended upon for recalling to mind the obliterated picture. This optical condition is just what is needed for continuous presentation to the senses of the successive phenomena in the environment of an individual, but it has the corresponding disadvantage that no visual record can be obtained by purely ocular means. If in the photometer a balance be observed between the illuminations produced by a test lamp on one side and a standard lamp on the other, one can note and record the observed equality, but when the observer's eye is turned aside there is left no available automatic record of the balance.

The sensitive film in the photographic camera possesses the opposite qualification of integrating and registering the chemical effect of any luminous stimulus that may be admitted to incidence. The law of integration is not a simple one, because the first incident ray produces the strongest effect and subsequent incidences continually dwindling effects, but the record is at least faithfully kept within these limitations. The camera is thus able, theoretically, to carry out that recording of luminous stimuli which the eye cannot accomplish. There arise, however, various difficulties. Thus, the camera and the eye do not judge of luminous intensities alike. The camera is much more partial to the violet end of the spectrum than is the eye, so that two side-by-side illuminations which may appear equal to the eye, and which come from different sources of light, may photograph quite unequally. Consequently use must be made of a suitable filter screen, found experimentally, which applied to the lens of the camera may render it approximately equivalent to the eye.

An ingenious application of the camera to the determination of the candle-power distribution of fluctuating light-sources, such as arc-lamps, is given by Messrs. Herbert E. Ives and M. Luckiesch, this week, on page 153. The arc-lamp under test is allowed to develop its zonal illumination upon a conical test surface, and the rays of light scattered from the latter enter a somewhat distant camera during a long exposure. The photographed picture is a circular band of varying photographic depth. By including on the same picture a series of images of different luminous intensities in graded magnitudes the intensities falling on the zonal test surface can be approximately determined from leisurely made comparison.

The plan suggested promises well for the future after many existing difficulties in technique shall have been overcome. Apparently the camera would have to be standardized, as would also the sensitive films and the ray-filter. The dimensions and properties of the zonal test surface would likewise probably have to be worked out in detail, so as to avoid specular reflection. Then the duration of exposure and the technique of developing will come in for standardization. In order that the method may be generally available it will be necessary for different observers to obtain substantially similar results from it, without an inordinate amount of special training. Nevertheless, the prospect is here opened of securing automatic records of zonal candle-power distributions.

SYNCHRONOUS MOTOR PERFORMANCE.

We print in this issue an article on synchronous motor performance by Mr. Nicholas Stahl, in which an attempt is made to deal in a popular manner with an important subject. The theory of the synchronous motor is perhaps the most important subject in that part of electrical engineering which deals with power stations and the transmission of energy. The parallel operation of electric generators is based on a clear comprehension of the operation of synchronous machinery, of which the performance of the synchronous motor is merely a special case.

For purposes of theory and clear conception of fundamental principles the treatment inaugurated by Dr. John Hopkinson and elaborated by Blakesley, Kapp and Blondel is so lucid and beautiful that it would seem futile to make an attempt to improve upon it, or to force the old wine into new bottles. Dealing with electromotive forces, and only indirectly referring to the saturation curve, the problem has been solved so successfully that we should disparage any attempt at meddling with its simplicity. However, the exigencies of practical work and the tendency to develop a sort of "slide rule" theory which, though somewhat loose and inaccurate, is yet a good makeshift for the erecting man and station operator who likes a rough and ready method without the necessity of comprehending fundamental principles, have given rise to many attempts at dealing with the question to meet the requirements of these people, and the article prepared by Mr. Stahl is, therefore, worthy of their notice. It must always be remembered, however, that the return to fundamental principles is the only safe way in engineering practice, and that the labor of so doing is usually amply repaid by a clearer comprehension.

CONVENTION OF THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

(*By Telegraph.*)

The twelfth annual convention of the National Electrical Contractors' Association was formally opened at the Hotel Albany, Denver, on the morning of July 17. A special train from Chicago over the Union Pacific brought ninety-seven members and their families, while forty Missouri representatives came on a special car over the Burlington route. The session was opened with an address by Mr. W. P. Carstarphen, representing the local contractors' association. He was followed by Governor Shafroth, who gave a strong talk on Colorado's resources, and drew attention to the present check to water power and other developments due to federal taxation of such utilities in the newer states. Mayor Henry J. Arnold, of Denver, in extending Denver's welcome, commented on the rapid electrical growth of Denver, and elaborated on some of the city's plans for future electrical beautifications. He also spoke of the conduit ordinance of Denver and the good it has done in preventing irresponsible workmanship. Mr. Maurice Biscoe, president of the local chapter of the American Institute of Architects, spoke briefly of the problems arising between contractors and architects, and Mr. C. N. Stannard, of the Denver Gas & Electric Light Company, in the absence of Mr. A. F. Traver, made an appeal for close co-operation between contractors and electric light companies, which was enthusiastically received. Mr. Stannard emphasized that it is just as necessary for contractors to secure profits from installation work and the sale of devices, as for central-station companies to profit from the sale of energy. The meeting adjourned at noon and abstracts of the other sessions will be given in a subsequent issue.

CONGRESS OF THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

The International Association for Testing Materials will hold its sixth congress in New York, Sept. 3-7, 1912, as already noted in our issue of May 11, page 1013. The tentative program for the congress, which will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, has recently been announced. Delegates to the congress will register on Monday, Sept. 2, during the morning and afternoon. In the evening a reception will be held under the auspices of the American Society for Testing Materials, with the co-operation of the American Society of Mechanical Engineers, the American Institute of Mining Engineers and the American Institute of Electrical Engineers. The formal opening will take place on Tuesday morning, Sept. 3, with addresses of welcome by national, state and municipal officials. Meetings of the various sections will be held during the afternoon, and a reception will be tendered by the American Society of Civil Engineers in the evening. Section meetings will take place on Wednesday, Sept. 4, to Friday, Sept. 6, inclusive. The final general meetings and closing of the congress will take place on Saturday morning, Sept. 7. On Sunday, Sept. 8, a special train will take such of the delegates as wish to join the party, on a trip to Washington, D. C.; Pittsburgh, Pa.; Buffalo, N. Y.; Niagara Falls, N. Y., and Bethlehem, Pa., returning Sept. 14, for the purpose of visiting the various government bureaus and industrial works of interest.

The provisional list of papers to be presented at the congress is classified under three grand divisions: First, metals; second, cement, stones and concrete, and third, miscellaneous. A partial list of the papers, including only those dealing with or related to electrical subjects, is given below:

"Electrical Disintegration of Metals and Its Possible Use for Testing Purposes," by Mr. C. Benedicks; "Influence of Electrolytes on Broken-down Metals," by Mr. H. Baucke; "Behavior of Copper in Impact Tests," by Mr. F. Baucke; "Magnetic and Electric Properties of Materials in Connection with Their Mechanical Testing," by Mr. C. W. Burrows; "Thermoelectric Determination of Elastic Limit," by Messrs. Capp and Lawson; "Relation of Tensile Properties of Steel to Magnetic and Other Hardness Tests," by Mr. R. P. Devries; "Relation Between the Structure of Metals and Their Electric Properties," by Mr. W. Broniewski; "Dependence of the Magnetic Properties of Iron and Steel on Temperature," by Mr. Creuzot, of Schneider & Cie; "Magnetic Properties of Iron Sheets for Dynamos," by Messrs. De Nolly and Veyret; "Electric Resistivity of Special Steels," by Mr. O. Boudouard; "Measurement of the Depth of Cracks in Materials Which Conduct Electricity," by Mr. O. Gallander; "The Effect of Electrolytic Action on Concrete," by Mr. C. de Wyrell; "Rubber Tests," by Mr. E. Camerman; "The Present State of Rubber Analysis," by Mr. J. W. Hinrichsen; "Mechanical Tests of Rubber," by Mr. K. Memmler, and "Rubber Testing," by Mr. P. L. Wormeley.

Except the representatives of public bodies and scientific societies, only members of the International Association for Testing Materials may participate in the congress. The fee for participation will be $5, and a fee of $3 will be charged for each lady or guest accompanying a member. The expenses for the trip by special train will amount to about $50 for each person.

PROBABLE ELECTRIFICATION OF ILLINOIS CENTRAL SUBURBAN SERVICE.

As the result of negotiations between the city authorities and the Illinois Central Railroad Company in relation to exchanges of land and frontal rights on the shore of Lake Michigan between Twelfth and Fifty-first Streets, Chicago, it is believed that the company has practically agreed to the electrification of its suburban railroad service, at least within the district named, within a period of five years. Provision for electrification does not include a specific date, but the railroad company, if the contract is finally executed, agrees not to use a newly acquired right-of-way from Thirty-first Street to Forty-ninth Street until it has put in operation four tracks by some other power than steam. Four tracks is the number now required to carry the suburban service. The negotiations, known as the "shore contract," relate to an extensive park and boulevard system for the shore of Lake Michigan and provide for rearrangement of the company's tracks. The company's right-of-way runs along the lake shore for a distance of several miles in the heart of the city. At the present time it appears that both sides will make concessions by which the shore line will be obtained by the city for park purposes, the company being compensated in other directions. This improvement involves the electrification of the suburban service at least.

OPENING OF NEW NORTHWESTERN STATION, COMMONWEALTH EDISON COMPANY.

On July 15, 1912, the first 20,000-kw unit in the new Northwest generating station of the Commonwealth Edison Company, Chicago, was placed in regular service. This unit consists of a Curtis vertical steam turbine and a 4500-volt, three-phase, 25-cycle generator, and ultimately there will be six such units, each with its own boilers, transformers and switching gear. The initial equipment will consist of two units, the second of which will be ready for preliminary test the latter part of next month. Work has been in progress on this station for over two years, but

certain delays have been unavoidable. The first announcement of the company's plans for this station appeared in the *Electrical World* on March 17, 1910, and at that time the proposal to employ 20,000-kw generating units was made for the first time. An illustrated article describing this station, then well advanced toward completion, appeared in our issue of June 1, 1911. Since that time the company has ordered a 25,000-kw turbo-generator of the Parsons horizontal type for its Fisk Street station, which it is expected will be ready for operation early next year.

BOSTON CONVENTION OF THE S. P. E. E.

An account of the opening sessions at the annual convention of the Society for the Promotion of Engineering Education, in Boston, on June 25 to 29, was given in our issue dated July 6.

During the convention a joint meeting was held with the American Institute of Electrical Engineers' when a committee—consisting of Dean J. P. Jackson, of the Pennsylvania State College, as chairman, and Dr. C. P. Steinmetz, Union University; Dr. Samuel Sheldon, Brooklyn Polytechnic Institute; Prof. W. I. Slichter, Columbia University, and Prof. H. H. Norris, Cornell University—presented its report on engineering education. An abstract of this report was given on page 29 of the issue of *Electrical World* for July 6.

An animated discussion followed the presentation of the report of the educational committee. Mr. H. G. Stott explained the evolution of the school which is being conducted by the Interborough Rapid Transit Company. The company required resourceful young men such as could not be picked up at random. College graduates could not be held for long periods, as the work became irksome to them. Finally the company began systematic instruction of the boys, who usually had only a grammar-school education, and the results have been gratifying. Boys who do not study are ineligible for promotion. Mr. W. H. L. Hale, head instructor of the Pennsylvania Railroad Apprentice School; Mr. A. L. Rohrer, electrical superintendent of the General Electric Company, Schenectady Works; Principal A. L. Williston, of Wentworth Institute; Prof. W. S. Franklin and others followed Mr. Stott and reinforced the arguments of the committee. Particular interest centered in the Bridgeport (Conn.) Trade School, which all agreed to be a school well adapted to industrial conditions. Professor Franklin and others especially indorsed the nine-hour day used in that institution. Professor Norris read from a letter written by Superintendent Frank Glynn of the school giving details of the work and particularly stating that full credit is given in the machinist's trade for time spent in the school. Professor Norris advised those interested to send for a copy of the monthly magazine, *The Artisan*, which is entirely a school product and gives a pleasant impression of the school spirit.

The hope of the educational committee is that this session will mark a distinct advance in the interest of the Institute members in vocational training. As Professor Slichter stated, to know what is being done in the industries and in public and private industrial schools is to become enthusiastic over the possibilities in this line.

SYMPOSIUMS ON TECHNICAL EDUCATION.

The program of the meeting comprised four divisions treating of specific features of educational work. These were (1) teaching physics to engineering students, (2) training instructors for technical school work, (3) efficiency in college administration, and (4) improving the equipment of technical school laboratories. The number of papers forming the complete program is so large that abstracts of only a few typical ones can be given here.

In papers by Professors Franklin and MacNutt on the teaching of physics to engineering students the current methods of teaching physics were criticised, examples of style from current text being held up to ridicule. To show their position the authors contrasted these two statements:

"(a) Energy can be neither created nor destroyed.

"(b) The work done by a weight depends only on its initial and final positions, and it is hopeless to seek a roundabout method for bringing the weight back to its initial position by the expenditure of a lesser amount of work."

Contrasting such statements as these leads to the general conclusion that "every statement of principle or fact in physics should take a form which suggests trial and verification, and every physical definition should take a form which represents the underlying physical operation." The authors believe that current practice in text preparation violates this fundamental principle. They present a plea for "homeliness" in the expression of physical quantities and laws. For example: "A well-known textbook on physics calls boiling *ebullition*, uses the heading 'Compressibility of Aeriform Bodies,' and speaks of vaporization as the 'solution of a liquid in aeriform bodies.'" The absence of "homeliness" is here quite conspicuous.

In the discussion of the papers several speakers took issue with the authors. A communication from Prof. R. F. Deimel, Stevens Institute of Technology, was read. In this he emphasized the fact that one purpose of education is to teach the student to deal with abstractions. This purpose he considered to have been overlooked by the authors, whom he criticised on a number of minor points, while expressing appreciation of the main purpose of the paper. The general impression created by the discussion was that, while certain details aroused opposition, it is necessary to get the treatment of physics into comprehensible language.

SYMPOSIUM ON TRAINING OF ENGINEERING TEACHERS.

On Thursday evening Dean G. C. Anthony, of Tufts College, who is a vice-president of the society, presided over a well-attended session at which papers on the training of engineering teachers were presented by Profs. J. T. Faig, University of Cincinnati; S. C. Earle, Tufts College, and H. H. Norris, Cornell University, and by Dean W. F. M. Goss, University of Illinois. In opening the session the chairman explained clearly the qualifications which an instructor should possess. He took up in detail the matter of supervising the work of instructors and gave the result of an investigation which had been made by Dr. Samuel P. Capen as to the attitude of a number of schools toward this question. It appears that there is no systematic method of keeping track of instructors' work in general use, and yet it is obvious that some means should be provided for doing this.

Dean Goss treated the matter of staff supervision in a broad, comprehensive way. He called attention to abuse of the so-called "academic freedom." The professor is more or less a law unto himself; that is, in the words of Dean Goss, "The professor may rise in the morning if he feels like it, may meet his classes if he feels like it, and if he meets them he may give them such instruction as he may wish to impart." Dean Goss pleads for an orderly conduct of affairs in teaching which shall be commonly understood and respected and which shall have the desired educational effect. The purpose of a staff organization is to provide responsible leadership. It should be definite so that each member shall know who is his immediate superior and who are his subordinates. And yet the superior should not be a taskmaster but rather a mentor to those under him.

In a paper on the effect of co-operative courses upon instructors Professor Faig explained how the co-operative courses at the University of Cincinnati, in which courses the students spend alternate weeks in school and in com-

mercial shops, have reacted upon the instructor. This reaction has occurred for three reasons: (1) Because, as the practical work in which the students are engaged must co-ordinate with the classroom work, the instructors are forced to connect theory and practice to satisfy their students; (2) the suggestions received by instructors from engineers, superintendents, foremen and others who have to do with the students give the instructors an insight into the results of their work, and (3) the co-operative students influence the instructors by transmitting the atmosphere of the shop to the classroom and by their practical knowledge of the subjects in which the instructors are endeavoring to teach them the theory.

Professor Earle described an experiment which he has been trying for some years and in which an instructor serves for a year as an apprentice instructor. During this time the apprentice does no responsible teaching, but, by assisting in the marking of reports and papers, by study of the details of the courses which he is to teach and by general study of the subjects bearing upon those courses, he gradually becomes fitted to take up this work. Professor Norris gave some details of the working of a faculty seminary in which various plans have been used to improve the quality of instruction.

In the discussion of these papers Dean J. P. Jackson emphasized the fact that teaching is not a simple matter and that, while all schools have not gone into the matter of teacher training as thoroughly as might be desired, still as a whole the responsibility of the work is recognized and strenuous efforts are being made to increase administrative efficiency. He contended that non-teaching engineers can have no adequate realization of the problems involved. Dean H. T. Eddy, of the University of Minnesota, gave the results of his experience with advanced classes of graduate students and professors and contended for the improvement of instruction by stimulating instructors to continue advanced studies in their specialties. Other speakers took up further details along the same line.

SCIENTIFIC MANAGEMENT.

On Friday morning, in the foundry of Wentworth Institute, a unique program of papers relating to the bearing of "efficiency engineering" on college work was presented under the direction of Mr. Frank B. Gilbreth, a vice-president of the society. A number of leaders in this new field were present to take an active part in the discussion, but, as the number of papers to be presented was large, no discussion beyond that contained in formal papers was possible. By strict enforcement of the time-limit rule every speaker had a reasonable opportunity to present his views.

Papers were presented by various efficiency advocates, including Messrs. Harrison Emerson, H. L. Gantt, Sanford E. Thompson, R. B. Wolf, Hollis Godfrey, H. F. J. Parker, H. K. Hathaway, William Kent, R. T. Kent, G. H. Shepard, Wilfred Lewis and the chairman. In addition to these the symposium contained papers by the following educators: Dean W. F. M. Goss, Profs. Hugo Diemer, L. J. Johnson, H. Wade Hibbard and Walter Rautenstrauch and Mr. Meyer Bloomfield. These eighteen papers taken together form a remarkable collection.

The papers are of two varieties, general and specific. The chairman's opening remarks covered the general principles of scientific management as applied to getting work done. They were visualized by means of a diagram showing the relations of the individuals in a completely organized establishment. Other general papers were given by Mr. Emerson, on educational demands of modern progress, and by Mr. Meyer Bloomfield, on education and efficient living. The other speakers took up specific problems relating to the application of the principles of efficiency to college administration; the teaching of scientific management in colleges, and the connection of scientific management with good citizenship.

LABORATORY EQUIPMENT.

Two sessions of the Boston meeting were conducted in sections, each confining attention to details of equipment of one type of laboratory. By this plan small groups of specialists got together to discuss their own problems. These meetings were unique in that they were probably the first comprehensive gatherings of teachers of civil, mining, mechanical and electrical engineering respectively. The result was enthusiastic indorsement of the scheme and a demand for a continuation of the effort thus begun to secure co-operation. A total of more than fifty papers were presented before these sections separately. The papers covered both details of equipment and methods used in conducting laboratory courses. At the beginning of each session, before breaking up into groups, the sections combined to listen to the presentation of papers of a general nature. Prof. F. P. McKibben opened the Friday afternoon session with a paper entitled "The Design, Equipment and Operation of University Testing Laboratories." On Saturday morning Dr. R. R. Heuter delivered an illustrated lecture on "The Engineering Laboratories of the Royal Technical University at Charlottenburg, Germany."

The meetings of these laboratory sections resulted in the appointment of special committees in each division. These committees expect to lay plans for immediate co-operation in their respective fields and, if they accomplish what they hope to do, the results of the 1912 meeting of the society will be of substantial benefit to technical education.

SOCIAL FEATURES.

Although the society meeting began a day later than that of the Institute, the members planning to attend it were invited to come a day early and enjoy the recreation provided for Tuesday by the local committee of the Institute. A large number accepted the invitation and participated in the program described in last week's issue of the *Electrical World*. In addition to this and other entertainment provided by the Institute, the local committee of the society had arranged an entertainment program which worked in well with the other. On Wednesday Harvard University provided a luncheon at Harvard Union after the morning session, which was held in Pierce Hall. In the afternoon the buildings and equipment of the university were inspected under the guidance of Prof. H. E. Clifford, the party being joined by many members of the American Institute of Electrical Engineers.

On Wednesday evening the annual dinner of the society was held at the University Club in Boston. Addresses of welcome by the presidents of the leading technical schools of the vicinity or their representatives and the presidential address of Dean Raymond were the features of the gathering. These were followed by an unplanned and informal discussion by prominent members regarding the purposes and activities of the society.

Tuesday afternoon was occupied with visits to the General Electric Works at Lynn and to the educational institutions in Boston. On Friday, at noon, between the symposium session on "efficiency," held in the foundry of Wentworth Institute, and the laboratory equipment session, held at the Massachusetts Institute of Technology, the former institution tendered the society an informal buffet luncheon. After the latter session and immediately following an inspection of the laboratories of the Institute a reception was given by the "Tech" in the Institute library.

On Friday evening the local committee of the society invited the members of the A. I. E. E. and of the Society for the Promotion of Engineering Education to join in a "Dutch" lunch and informal smoker in the main ballroom at Hotel Somerset. This followed a short semi-technical, semi-business session at which resolutions of thanks to the efficient local committees and to the individuals and institutions behind the committees were passed enthusiastically.

BUSINESS MATTERS.

During the meeting the council of the society met several

times for important work and the society held two executive sessions. The constitution of the society was amended slightly to comply with post office regulations regarding second-class rates for the *Bulletin*, and also to give the council greater freedom in choosing meeting places for the annual meetings. An action which will undoubtedly result in definite improvement of the work of the society was the appointment of special committees on improvement of instruction in several branches of engineering; namely, civil, mining, electrical and mechanical. The chairmen of these committees are Profs. F. J. McKibben, Lehigh University; F. W. Sperr, Michigan College of Mines; Charles F. Scott, Yale University, and A. M. Greene, Jr., Rensselaer Polytechnic Institute. A fifth committee on college administration, with Dean F. L. Bishop, University of Pittsburgh, as chairman, was also appointed. These appointments are in line with suggestions from the University of Illinois members of the society regarding a more systematic layout of committee work, somewhat along the lines of the plan used by the American Railway Engineering Association. This important matter was referred to the retiring president and the program committee, which immediately prepared a plan and will submit it to the council for approval. The plan comprehends a central committee on committees, to which shall be referred suggestions regarding suitable committee work and which shall also have the power to initiate plans for such work. The central committee is to report to the council, which may direct the central committee to appoint the necessary special committees.

RESULTS OF SEVEN YEARS' OPERATION OF THE SEATTLE MUNICIPAL PLANT.

In the annual report of the Lighting Department of the city of Seattle, Wash., for the fiscal year ended Dec. 31, 1911, which contains a review of the financial operations of the Seattle municipal plant since it was first placed in commercial operation in 1905, is found an example of the success which sometimes attends municipal operation when the venture has the support of citizens and local authorities imbued with a proper sense of public duty, civic pride and a desire to work in unison for the common good. The tendency in Seattle has always been toward municipal ownership of public utilities, especially that of lighting. As far back as 1869 the charter granting the City Council authority to light the streets provided for the erection of such works as might be necessary to that end, while various amendments to the charter in later years made further provision for municipal ownership and helped to bring the matter before the public from time to time.

The movement for municipal ownership of lighting facilities began to assume a tangible form in January, 1902, when the board of public works submitted plans to the City Council for a municipal plant, and a little later in the same year a proposition to issue $590,000 par value of bonds for the purchase or construction of a city lighting plant was carried by a three-fifths vote at a municipal election. Construction was started in April, 1902, and on Sept. 9, 1905, the city lighting department began taking applications for lighting and motor service. Since 1905 the city system has grown rapidly, and there is now in operation an 11,000-kw hydroelectric development on the Cedar River from which energy is transmitted 39 miles at 60,000 volts to Seattle, as was described in the *Electrical World* of June 1, 1912.

The immediate effect of municipal ownership of lighting service in Seattle was a downward revision in the schedule of rates for energy supplied by the central-station company in the city. In and previous to 1902 a rate of 20 cents per kw-hour for residence lighting was asked by the competing company, and when the municipal agitation became active, a reduction to 12 cents per kw-hour was made. The city plant began in 1905 with a residence rate of 8½ cents per kw-hr. for the first 20 kw-hr., 7½ cents per kw-hr. for the next 20 kw-hr., 6½ cents for the next 20, and 4½ cents per kw-hr. for all in excess of 60 kw-hr. per month. This schedule was immediately followed by a reduction in the central-station company's rates of 16⅔ per cent and this cut was followed early in 1911 by a further reduction of 5 per cent. When on July 1, 1911, the municipal rates were lowered to 7 cents for the first 60 kw-hr. and 4 cents per kw-hr. for all energy used in excess of 60 kw-hr. per month, the private company followed this with a schedule making its rates the same as those charged for the municipal plant service. Since 1902 there has been a reduction of 65 per cent in the residence rates of the local company.

On July 1, 1912, the municipal rates on residence lighting where the service has been in use for twenty-four months became 6 cents per kw-hr. for the first 60 kw-hr. and 4 cents for all energy used in excess of 60 kw-hr. per month, with a minimum charge of 75 cents per month for such customers. The average business rate charged for the municipal service is 3 cents per kw-hr., and the average rate for motor service is 2 cents per kw-hr. The method of computing these rates from logarithmic curves was noted in the article in the *Electrical World*, June 1, 1912, referred to above. Reductions have also been made in the cost of street lighting service since the establishment of the municipal plant.

Although these low rates have not been a source of large profit, the revenue received has fully waranted the erection and operation of the plant. The financial statements of the city lighting department, which have been compiled in abundant detail, show that from the end of 1905, when a deficit of $18,876 was recorded for that year's operation, the revenues of the municipal plant have improved steadily, as is shown in the accompanying table.

STATEMENT OF REVENUE AND EXPENSE.

	1905.	1906.	1907.	1908.	1909.	1910.	1911.
Total revenue	$45,470	$117,299	$198,793	$317,840	$468,386	$598,514	$727,383
Total expenses	64,346	88,819	129,475	186,882	225,864	299,550	412,367
Balance	.....	28,480	69,317	130,958	242,522	298,964	315,015
Depreciation	.....	39,505	45,231	104,424	143,063	195,537	161,581
†Surplus	*18,876	*11,025	*‡5,815	20,718	99,459	103,427	153,434

*Deficit for year.
†The surplus revenue is consumed by extensions, construction and liquidation of liabilities.
‡After applying $24,086 toward deficit for years 1905 and 1906.

The balance sheet as of Dec. 31, 1911, shows total assets and liabilities of $3,614,713. Funds on hand are given as $301,374, total plant investment as $3,636,187, the net value of which after deduction of $664,797 for depreciation is placed at $2,971,396. Th bonded indebtedness is $2,240,000. The surplus revenues since commencement of operation, amounting to $377,038, have been absorbed by extensions and new construction.

CALIFORNIA PUBLIC UTILITIES ACT.

The Governor of California on Dec. 25, 1911, approved the public utilities act passed by the State Legislature, and on March 23, 1912, the act became law. This act is administered by the Railroad Commission, which consists of five members appointed by the Governor from the State at large for six-year terms. Powers are conferred upon the commission to regulate the rates, schedules and service of common carriers and public utilities operating within the State, subject to certain exceptions later mentioned. All charges for service must be just and reasonable, and every unjust or unreasonable charge is prohibited and declared unlawful. Every public utility is required to furnish adequate, efficient and reasonable service, with equipment and facilities consistent with the promotion or the safety, health, comfort and convenience of its patrons, employees and the public. Every public utility is required to file a copy of its rates and schedules with the commission and keep a copy of the same open to public inspection. It is prescribed that no public utility has commenced construction under a franchise which the commission has jurisdiction, shall exceed the rates which were in effect on Oct. 10, 1911, unless authorized by the commission. Every public utility is forbidden to practise discrimination or exercise any prejudice whatsoever as to rates, service or facilities, in respect either to locality or as between different classes of patrons.

The commission is given authority to encourage economies and improvements in public utilities and to permit the distribution of any profits therefrom to which the utility companies may fairly be entitled. No common carrier and no telephone or telegraph corporation may charge more for a shorter than for a longer haul or transmission over the same line or route in the same direction within the State. Foreign corporations not complying with the State laws are forbidden to transact a public utility business within the State, interstate commerce excepted. The commission is given proper power to compel physical connection between two or more telephone or two or more telegraph systems whose lines can be made to form a continuous route of communication, when this can reasonably be done and public convenience requires it. The commission is also given authority to compel any public utility to conduct its business with proper regard for the health and safety of its employees, patrons and the public. Just and reasonable standards for public utility service may be fixed by the commission after a hearing upon its own motion or upon a complaint. Periodical tests or inspections of service may be provided for. Public utility accounts must be kept in the form and manner prescribed by the commission, and every public utility must provide adequately for depreciation out of its revenue, and shall carry a depreciation reserve fund. The commission is empowered to ascertain the value of the property of every public utility and make revaluations from time to time as may be necessary.

No street railroad, gas, electric, telephone or water corporation shall henceforth begin construction of any plant or system or any extension thereof without having first obtained from the commission a certificate that present or future public convenience and necessity require such construction. This also applies to the right to exercise franchises or permits granted by local authorities. Exception to these provisions is made in the case of a utility desiring to build local extensions within any city, town or county which heretofore it has lawfully occupied and served, or foreign extensions into continguous territory not heretofore served by a public utility of like character. Franchises or permits heretofore granted but not actually exercised, or the exercise of which has been suspended for more than one year, become void and a certificate of public convenience and necessity must be applied for, except that when the commission shall find, after a hearing, that a public utility has commenced construction under a franchise granted before the law took effect and is carrying the work forward with all reasonable diligence, this rule may be suspended.

If a public utility desires preliminary authority to exercise a franchise not yet formally granted it may apply to the commission for a preliminary order, and in the subsequent event of obtaining the franchise a formal certificate will be issued in accordance with the order. No common carrier or public utility shall place any lien upon its property or shall issue any stocks, bonds, notes or evidence of indebtedness except with the consent and approval of the commission. Such stocks, bonds, etc., shall be issued only for the acquisition of property, construction of plant and improvements in service. No public utility shall hereafter purchase or acquire any part of the capital stock in any other public utility without first obtaining the authorization of the commission. All public utilities are subject to the commission's power to require a full accounting of the proceeds from all sales of stocks, bonds or other evidence of indebtedness. The commission is authorized to adopt its own rules of practice and procedure in hearings and investigations held by it and the technical rules of evidence are specifically waived. Full powers are conferred upon the commission to ascertain all pertinent facts, examine books and records, inspect property, compel attendance of witnesses and administer oaths in connection with any complaint or investigation before it. After any order or decision has been made by the commission the affected parties may apply for a rehearing, and if the same is denied application may be made within thirty days to the Supreme Court of the State for a writ of certiorari for the purpose of having the lawfulness of the original decision or order inquired into and determined.

One of the novel features of this act is contained in the provision that any city and county or incorporated city and town may vote at a public election on the question of whether they will vest their powers of regulating public utilities doing business therein with the commission or retain such power to themselves, and until these elections shall be held such powers of regulation shall continue unimpaired in each city and county or incorporated city and town. It is also provided that where such city and county or incorporated city and town have voted to retain their powers of regulation they may change this decision thereafter by public vote, and, moreover, when such powers have been relinquished to the commission they may be recovered at any time by like vote.

CALIFORNIA DECISION IN THE PACIFIC GAS AND ELECTRIC CASE.

As announced in our columns last week, the California Railroad Commission has handed down a decision in the case of the Pacific Gas & Electric Company versus the Great Western Power Company, in relation to competition between like public utilities and the grounds which justify the grant of a certificate of public convenience and necessity. Because of the rather sweeping character of the opinion and the radical declarations of policy on the part of the commission the decision is of unusual interest and importance. Briefly the complainant, the Pacific Gas & Electric Company, on April 26, 1912, complained that the Great Western Power Company had constructed or was in the act of constructing, or surveying for, certain transmission and electric distribution systems in the counties of Solano, Napa, Sonoma and Marin, without securing the necessary franchises or the necessary certificate of public convenience and necessity. The defendant company on May 6 filed applications for certificates of public convenience and necessity, under sections 50 (a), 50 (b) and 50 (c) of the public utilities act, covering substantially all

of the construction completed, under way or contemplated, which the complainant cited. On May 9 the defendant filed an answer to the specific complaint, and on May 28 the plaintiff filed a protest against the defendant's applications for certificates of public convenience and necessity.

The several complaints and applications were combined as one case and hearings were held at Santa Rosa, Napa, Vallejo and San Francisco. At these hearings five other electric utility companies filed protests against granting the certificates applied for by the defendant. These companies included the California Telephone & Light Company and the Cloverdale Light & Power Company, operating in various parts of Sonoma County; the Napa Valley Electric Company, supplying a large part of Napa County; the Vallejo Electric Light & Power Company, serving the city of Vallejo, and the Vacaville Water & Light Company, serving the city of Vacaville.

On June 18 the commission handed down an 8000-word decision and order which has unusual interest because it establishes an important precedent in California and differs radically from the policies established by some of the older commissions under similar laws. The gist of the finding is as follows:

"The present and future public convenience and necessity require and will require (a) the granting of the application of Great Western Power Company under the provisions of Section 50 (*a*) of the public utilities act as to all sections of Solano County outside of incorporated cities and towns, except the territory now served by the Vacaville Water & Light Company; all sections of Napa County outside of incorporated cities and towns other than the territory now served by the Napa Valley Electric Company; all sections of Sonoma County outside of incorporated cities and towns other than the territory now served by the Cloverdale Light & Power Company, and the California Telephone & Light Company, except the southern end of the Sonoma Valley in and about Shellville; also the cities or towns of Napa, Santa Rosa, Sebastopol, Petaluma, Dixon, Suisun and Fairfield, and also (*b*) the granting of the application of Great Western Power Company under the provisions of Sections 50 (b) and 50 (c) of the public utilities act, referring to the approval of franchises, as hereinafter in this order specified." The defendant's application was also granted to the extent of permitting the sale of energy to the city of Vallejo for municipal purposes and to the Vallejo company. The application was furthermore granted as to other incorporated cities and towns in the affected territory, if any, not now supplied with electric energy.

After reciting the preliminary facts in the case the decision quotes in full the three clauses comprising section 50 of the public utilities act, which is abstracted elsewhere in this issue, and then continues with the following language:

"While the general intent of this provision of the act is plain, its application to a particular contingency is surrounded by much difficulty. It certainly is true that where a territory is served by a utility which has pioneered in the field, and is rendering efficient and cheap service and is fulfilling adequately the duty which, as a public utility, it owes to the public, and the territory is so generally served that it may be said to have reached the point of saturation as regards the particular commodity in which such utility deals, then certainly the design of the law is that the utility shall be protected within such field; but when any one of these conditions is lacking the public convenience may often be served by allowing competition to come in. It has been urged in this proceeding that where a utility occupying a field has generally served such field so that the advent of a second utility would merely serve to divide the business, then if the existing utility has the ability, if it choose to do so, to furnish such territory efficiently and at as reasonable rates as can be legitimately accorded by the utility desiring to enter the field, even though it had heretofore charged excessive rates or given inefficient service, yet sound economy would require the authority which has the power to regulate the rates and service of such utility, to require the existing utility to furnish such territory adequately and cheaply and to keep the second utility out. Theoretically much can be said in favor of this contention, but to attempt to apply it would in practice defeat the very intent of the public utilities act in all cases where utilities did not voluntarily accord to their patrons those things which are their due or, at least, would impose upon the public authorities the burden of forcing such utilities into a realization of what their proper relationship to the public is. In times past in this State efforts on the part of public authorities to force utilities to give reasonable rates and adequate service have been met with long continued litigation, and if the public authorities have at hand an efficient and summary method of forcing public utilities to accord to their patrons such reasonable rates and adequate service, then, in our opinion, it is their duty to use it. If any territory served by an existing utility is afflicted by such utility with excessive rates or inefficient service, and a second utility of the same kind desires to enter such territory and this commission should say to the existing utility 'although when you had matters your own way, you lost sight of your duty to the public, yet we will still preserve for you this territory in consideration of your future good behavior,' in how many instances does anyone suppose a new utility would apply to enter a territory served by an existing utility when the only effect of all its trouble and expense would be the cheapening of the rate and the improvement of the service of the existing utility? And hence if we should in the very first important contested application for a certificate of public convenience and necessity announce the rule that where the major portion of a territory is served, though inefficiently and at high rates, the result of such application will be merely to put the existing utility upon its good behavior, then we would, in effect, be saying to all the offending utilities of this State, if there be any, 'you may proceed with your present methods until competition knocks at the door of your territory and only then will you be compelled to do justice,' and we would be saying to every new public utility 'you will knock in vain at the door of any field now served by a utility.' The result would be that old utilities would keep their territory unspurred by the fear of competition, knowing always that only when it was imminent need they prepare to do justice to their patrons, and the new utilities, having no incentive to apply for permission to go into territory more or less completely, but inefficiently served, would limit themselves to new fields, within which they would soon, in turn, assume the same attitude as would be assumed by the old utilities now doing business within the State. Rather, do we announce the rule that only until the time of threatened competition shall the existing utility be allowed to put itself in such a position with reference to its patrons, that this commission may find that such patrons are adequately served at reasonable rates. By announcing this principle we hope we shall hold out to the existing utilities an incentive which will induce them voluntarily, without burdening this commission or other governmental authorities, to accord to the communities of this State those rates and that service to which they are in justice entitled, and to the new utilities we shall likewise hold out the incentive that on the discovery by them of territory which is not accorded reasonable service and just rates, they may have the privilege of entering therein if they are willing to accord fair treatment to such territory. We understand the certificate of public convenience and necessity to be in this State largely a precautionary measure. We have already dealt somewhat at length with the cases wherein we believe competition should be allowed, even though such competition will mainly serve to take patrons from the existing utility. If, however, a territory is completely served and

the utility has, to the best of its ability, given fair treatment to its patrons, as already intimated, this commission will be slow to permit a competitor to come into its territory. One of the few cases where under such circumstances the competitor will be permitted to enter the field will be where the competitor can adequately furnish the commodity at a rate so much less than the rate which can be accorded by the existing utility, that the interests of the public demand the commodity at the lower rate. We are aware that this may work hardships upon small companies and we are likewise aware that the State owes a duty to the small utility which has gone into a field and furnished the inhabitants thereof with a service which would otherwise have been denied them. When the advent of the new utility, under such circumstances, will serve, through legitimate competition, to impair the investment of the existing utility, the difference in rates which may be legitimately accorded by the new utility must be so considerable that the public interest clearly demands the rendition of the service at the lower rate before this commission will be moved to permit the competitor to enter such field, provided always, as we have already said, that the existing utility, be it small or great, has been doing its best to treat its patrons fairly.

"Competition does not necessarily become duplication unless the field covered by a natural monopoly is completely served. California has just begun her development. We have no doubt that as a rule in this State the going in of a second utility will develop a considerable amount of new business, while leaving an ample field for the existing utility. Such being the case, the instances wherein this commission will deny a certificate of public convenience and necessity by reason of the fact that another utility is already in the field will be comparatively rare. If we had as dense a population as exists in some of the Eastern States and if our territory were supporting practically the limit of its population and practically all the territory of this State were covered by the plants of existing utilities, then under the rule we have already announced practically the only cases wherein a second utility would be permitted to compete would be those cases wherein the present utility was remiss in its duty to the public."

Referring to the permission given to the defendant to enter certain cities named in the order, the commission brought up two objectionable practices which ought to be discontinued. In the first place, the practice of charging to the consumer the cost of making extensions and permitting him to pay for the extensions in use of commodity, enables a company to acquire its property and thereby increase its capital out of its earnings, whereas the money obtained should be charged to income. Thus a company may extend its system throughout an entire county and make it appear that its revenue during the time of extension is nil, when, as a matter of fact, if correctly accounted for its revenue may show such an earning upon its capital invested that it would lead a rate-fixing body to determine that the rates, which apparently yield nothing, are too high.

The other vice singled out by the commision for comment is the absolutely unwarranted assumption of ownership of such extensions by the company, for the construction of which it has required the consumer to furnish the funds without according to him any return for the use of the same. The commission stated that if a utility desired to cover the fat territory comprised within its franchise it should be required, under ordinary circumstances, to cover the lean as well. If, under extraordinary circumstances, it appears that the hope of business is so remote as not to warrant an extension, and the consumer desiring the extension is willing to put up the money to provide the same, the ordinary canons of business decency, the commission holds, require that title to the extension should remain in him and not be added to the company's property in fraud of the consumer because he loses the interest, and in fraud of the public authority because the value of this extension is used to swell the total value of the plant for rate-fixing purposes.

The commission does not believe in rate wars which serve to reduce the earnings of a utility below a reasonable figure. While such rate wars may bring a temporary advantage to a locality, it is the opinion of the commission that they often react ultimately to the detriment of such locality. The commission suggests to the utilities that should they enter into a rate contest in cities over which it has no jurisdiction it will feel inclined to take as the standard of reasonableness for rates in territory within its control the standard set by these utilities within the territory over which it has no control.

CHICAGO COUNCIL PASSES ELECTROLYSIS ORDINANCE.

On July 16 the City Council of Chicago unanimously passed the pending ordinance designed to minimize the damage to underground metallic structures from electrolysis, accounts of which have appeared previously in our columns. According to last reports the city's expert estimates that the ordinance will require the traction companies to expend some $3,000,000 in installing negative booster systems, while experts for the traction companies represent that they will have to spend over $10,000,000. A strong controversy over this ordinance has been going on between the city and the traction interests, with Mayor Harison lending his full support to the city's side of the case. At one of the recent hearings one of the legal representatives of the companies stated that the ordinance, if passed, would be contested in the courts on the ground that it requires a needlessly large expenditure of money without direct return.

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION, FIRST DISTRICT.

The Public Service Commission for the First District recently made public the report of the Bureau of Gas and Electricity showing the number of gas and electric meters tested during the month of June, 1912. Of the electric meters, 11.5 per cent were found to be more than 4 per cent fast, 2 per cent were found to be more than 4 per cent slow and 86.5 per cent were found to be between 4 per cent fast and 4 per cent slow. Electric meters tested on complaint numbered 52.

Volumes II and III of the annual report of the Public Service Commission for the First District of the State of New York for the year ended Dec. 31, 1910, have recently been distributed. Vol. II, comprising 265 pages, contains the orders issued by the commission during 1910. The third volume, comprising 728 pages, is the statistical portion of the report.

NEW YORK COMMISSION, SECOND DISTRICT

The Public Service Commission, Second District, has approved of the exercise of franchises granted by the Nassau County board of supervisors and town superintendent of highways of North Hempstead to the Public Service Corporation of Long Island for the laying of gas mains for the furnishing of gas in the town of North Hempstead. At the same time the commission has denied the application of the Westbury-Hicksville Gas Company for consent to allow it to serve gas in the same territory.

In its decision the commission stated: "From all the proceedings and evidence in both cases the public highways in the town of North Hempstead are divided into state highways, county highways, county roads and town roads; that in order to supply the said town and the inhabitants

thereof with gas properly it is essential that there should be but one gas corporation engaged in said service, which gas corporation should be in a position to occupy all of the public highways in said town upon which there are residents who desire to use gas. The Public Service Corporation of Long Island has obtained franchises from the town superintendent of highways and also from the board of supervisors of the county, while the Westbury-Hicksville Gas Company has obtained only a franchise from the town superintendent of highways to occupy the town highways, and the board of supervisors of the county has refused to grant this company a franchise to occupy the county roads."

MASSACHUSETTS COMMISSION.

The Massachusetts Gas and Electric Light Commission has published its twenty-seventh annual report, covering the year 1911, and including the usual statistics of operation, reprints of decisions and legislation affecting municipal plants and gas and electric companies within the State. The report is a document of 239 pages, with an appendix of 426 pages. Fifty complaints were received by the board during the year. During the year the town of Boylston and the city of Springfield took adverse action against municipal ownership propaganda. The incomes of the electric companies of the State totalled $12,353,-109 for 1911, compared with $11,206,004 for 1910. The total expenses were $7,251,118, as against $6,738,093 for the previous year. There was a gain of about $640,000 in apparent profits, compared with an apparent deficit of $1,894,628 in the case of the gas companies of the State. The latter had a surplus of $520,110 for 1910, while the surplus of the electric companies increased from $1,855,383 for 1910 to $2,049,081 for 1911. The returns of the individual companies indicate that in general the central-station industry in Massachusetts is in splendid condition, and the expansion of earnings from year to year shows little evidence of abatement.

The board has issued a decision fixing the price of 4-amp magnetite arc lamps for street lighting in the city of Worcester at $80.30 per lamp-year, after a long and exhaustive investigation. The former price was $91.25 per year. Owing to the importance of the case an abstract of the decision will appear later.

OHIO COMMISSION.

The Ohio Public Service Commission has refused a certificate of public convenience and necessity to the Cranberry Home Telephone Company, which made application recently for permission to establish an exchange at New Washington. The application was resisted by the local telephone company, which asserted that the people already have good service and that a second system would inflict a hardship upon them. This is the first instance in which an application of this kind has come before the commission.

CALIFORNIA COMMISSION.

The California Railroad Commission has granted permission to the Oro Electric Corporation to construct an additional generating plant on Yellow Creek, a branch of the north fork of the Feather River, and construct a steel transmission line from that point into Alameda County and a branch line into Calaveras County. The company will extend its lines, supply energy for lighting and motor service in Plumas, Butte, Yuba, Sutter, Colusa, Glenn, Yolo, Solano, Contra Costa, Sacramento, Calaveras, San Joaquin and Alameda counties. The permission is granted, however, only on condition that those bonds of the corporation now held by the Oro Development Company and the Oro Water, Light & Power Company will not be sold until the consent of the commission is obtained.

WISCONSIN COMMISSION.

The Wisconsin Railroad Commission has issued a decision ordering the Rhinelander Lighting Company to abandon the rate schedules now in effect and to substitute therefor a schedule devised by the commission. The decision was in answer to a complaint, filed by citizens of Rhinelander, alleging that the rates for electric lighting in the city of Rhinelander were excessive and discriminatory. No objection was raised at the hearing to the commission's valuation of the physical property, but the attorneys for the defendant contended that an item of approximately $73,000 for intangible values should be included in the total valuation to be used for rate-making purposes. This amount included an allowance for franchise value which was based upon the estimated cost of the free service to be furnished the city in accordance with the terms under which the original franchise was granted. Inasmuch as this franchise was surrendered for an indeterminate permit, the conditions engrafted upon it were invalidated upon surrender, and the information concerning the cost of service up to the time of the exchange was too meager to furnish any estimate for a reasonable allowance. The defendant alleged further that the savings which have been effected through the substitution of purchased hydroelectric energy for steam-generated energy should be capitalized and made a part of the intangible value. The commission, however, was of the opinion that "the title of the owner of a utility business to the entire savings produced by the substitution of a cheaper power has not been clearly demonstrated," and that to grant the demand of the defendant in this connection would "preclude the public from enjoying any share in economic methods of service and would seem to place upon the users of utility service the burdens of maximum cost of operation."

From an analysis of operating expenses the commission deduced the following unit costs, which were based upon the physical valuation of the property: For one hour's use of the active connected load, 11.97 cents; for two hours' use, 7.01 cents; for three hours' use, 5.36 cents, etc. Upon these unit costs the following rate schedule was devised: A primary charge of 10 cents net per kw-hr. for energy used equivalent to the first thirty hours' use per month of the active connected load; a secondary charge of 7 cents net per kw-hr. for the next sixty hours' use, and an excess charge of 4 cents net.

In Class A, consisting of residences, when the total connected load is equal to or less than 500 watts, 60 per cent of such connected load is to be deemed active; when the installation exceeds 500 watts, 33.33 per cent of the part over and above 500 watts is to be considered active.

In Class B, consisting of stores, offices, business and professional places, etc., when the total connected load is equal to or less than 2.5 kw, 70 per cent is to be considered active; when the installation exceeds this value, 55 per cent of the excess is to be deemed active.

In Class C, consisting of city buildings and industrial establishments, 55 per cent of the total connected load is to be considered active.

The company has only a few metered consumers at present, but the commission's order provides that meters must be installed for all consumers within ninety days.

According to the present contract which the utility company has with the water power company no energy can be sold for motor service other than for fan motors. The commission held that the residents of Rhinelander were entitled to motor service and that either the defendant company must furnish such service or it must be supplied by the water power company itself. The schedule as ordered for motor service is as follows: A service charge of $1 per month for each installation of 1 hp or less, a charge of 75 cents for each additional horse-power up to 5 hp, and a charge of 50 cents per horse-power for each additional horse-power over 5 hp. In addition to the service charge there is to be a meter charge of 3 cents net per kw-hr. for the first ninety hours' use per month of the total installation and a charge of 2 cents net per kw-hr for all energy used in excess of that amount.

Current News and Notes.

The Rating of Oil-Engine Locomotives.—On page 117 of our issue dated July 13 attention was called to a 2000-hp, 125-km per hour Junkers oil-engine locomotive. A typographical error caused the machine to have the apparent rating of "125-kw per hour."

* * *

Long-Distance Independent Telephone Connection with Chicago.—It is now possible to talk over Independent long-distance telephone lines between Chicago and Grand Rapids, Mich. Mayor Harrison of Chicago talked to Mayor Ellis of Grand Rapids in this way on July 11, when the service was established.

* * *

Reduced Rates to Public Service Employees.—The counsel for the Public Service Commission of Maryland has given it as his opinion that it is unlawful for the Hagerstown (Md.) Light & Heat Company to furnish gas to its employees at rates below those charged to other customers. He says that in Maryland there appears to be no warrant of law to allow reduced rates to employees of gas and electric companies. The ruling providing for the same rates under the same conditions to all consumers applies to the company's employees as well as to other customers.

* * *

Engineering Education for Self-Supporting Boys.—Arrangements have been made by the Chattanooga Institute of Technology with the various manufacturers of that city according to which engineering students are enabled to earn all expenses while attending school. The time required for completing the course is 60 months. The student works in some industrial establishment for one week and attends the Institute the next week, thus devoting one-half time to study of theory and the other to practice while he is obtaining wages enough to pay all of his expenses. The president of the Institute is Prof. H. E. Bierly, Chattanooga, Tenn.

* * *

Compulsory Wireless Service.—Senator William Alden Smith's bill introduced shortly after the *Titanic* disaster, requiring all vessels carrying fifty or more passengers to have at least two wireless operators so that one may be on duty at all times, has been adopted by the House and is expected to receive the President's signature without delay. The bill is to go into effect on Oct. 1, 1912. The wireless apparatus must be powerful enough to receive and transmit messages at least 100 miles, and each vessel must have an auxiliary source of energy supply independent of the ship's main electric plant to maintain communication. On cargo-carrying vessels one first-class operator will be required, but another member of the crew will be required to understand the transmission of distress signals.

* * *

St. Louis Electric Club Outing.—The St. Louis League of Electrical Interests entertained its members and the members of the local section of the N. E. L. A., the American Institute of Electrical Engineers and the Engineers' Club, on an excursion on the evening of July 9. A dinner at 6:30 was followed by an address of welcome by Mr. Sam A. Hobson, president of the St. Louis League; his address being responded to by a representative of each of the organizations present. Following a vaudeville entertainment, songs by Mr. Charles Brainerd and music by the Union Electric Light & Power Company orchestra, Mr. Frank D. Beardslee, sales manager for the Union company, was presented with an umbrella, Mr. Beardslee being winner of a speakers' contest recently carried on by the league. Mr. Charles Sutter also received a prize as winner of a sub-contest carried on among the St. Louis electrical contractors.

* * *

New Commonwealth Edison Office Building.—It is now reported that all details in relation to the purchase of the Commercial National Bank Building by the Commonwealth Edison Company of Chicago have been completed. The building secured is a large twenty-story office building at the corner of West Adams Street and South Clark Street, Chicago. It will be used for the office headquarters of the Commonwealth company some time after Jan. 1, 1914, when the bank will be ready to move into a new building which it is erecting. The price paid is said to be $4,660,000, including $2,860,000 in cash, of which $1,000,000 has been paid, and the assumption of a mortgage of $1,800,000. The Commercial National Bank Building is a modern building and so large that no doubt a portion of the space in it will be leased to tenants. It was sold to the Commonwealth Edison Company by the Continental and Commercial National Bank.

* * *

Strawberry Tunnel Reclamation Project in Utah.—In celebration of the completion of the great Strawberry Tunnel reclamation project of the United States Government the town of Spanish Fork, Utah, put on gala attire on July 2, 3 and 4. The project is primarily for irrigation, bringing the waters of Strawberry Creek through the Wasatch Mountains by a tunnel into the Utah Valley. While the primary purpose of this great engineering work is irrigation a power plant has been created and it was among the features of the project inspected by the visitors. At the exercises in the city park of Spanish Fork on July 2 there were a number of speeches, including one by Mr. Heber M. Wells, formerly governor of Utah, and another by Chief Engineer Hill on "Reclamation Work." The cost of the work is stated to be $3,000,000 and it is estimated that the irrigation system will enable 60,000 acres of fertile soil to be reclaimed from the desert.

* * *

SOCIETY MEETINGS.

New York Railway Association.—The Street Railway Association of New York has changed its name to the New York Electric Railway Association. Mr. Charles C. Deitz, United Traction Company, Albany, N. Y., is the newly elected secretary.

* * *

Rate Research Committee Meeting.—A meeting of the rate research committee of the National Electric Light Association will be held on Aug. 7 on Associated Island in Lake Ontario. Plans for the work of the committee during the coming year will be taken up at this meeting.

* * *

Faraday Society Officers.—At the annual general meeting of the Faraday Society held in London on July 2 the following officers were elected for the ensuing year: President, Dr. R. T. Glazebrook; vice-presidents, Messrs. K. Birkeland, Robert Hadfield, F. W. Harbord, Bertram Hopkinson, Alexander Siemens and James Walker; treasurer, Dr. Mollwo Parkin, Ph.D.

* * *

The Institute of Operating Engineers.—The second annual meeting of the Institute of Operating Engineers will be held on Sept. 6 and 7 in the Engineering Societies Building, 29 West Thirty-ninth Street, N. Y. The main features will be the award of diplomas on Sept. 6 and the report of the constitution revision committee on Sept. 7. The afternoon of Sept. 6 will be devoted to the reading and discussion of technical papers .

ELECTRICITY IN NORTHWEST WASHINGTON.

Generating and Distribution System of the Whatcom County Railway and Light Company of Bellingham, Wash.

Simple Hydroelectric Station at Nooksack Falls in the Forest Reserve near International Boundary.—Steam Relay Station at Bellingham Burning California Fuel Oil.—Details of Development and of Oil-Burning Equipment.

THE Whatcom County Railway & Light Company, of Bellingham, Wash., supplies electric service to Bellingham, Burlington, Concrete, Glacier, Mount Vernon, Maple Falls, Lynden and Sedro-Woolley; also energy for railway service for Bellingham city lines and the 33-mile interurban railway from Bellingham to Mount Vernon and Sedro-Woolley, Wash.

Bellingham has a population of 25,000 and is located about 18 miles south of the international boundary line of the United States and Canada and is the most northern Puget Sound city of any importance. Lynden, with a population of 1200, is 14 miles north of Bellingham. Sumas is 20 miles north, northeast of Bellingham. Nooksack Falls is 35 miles east, northeast of Bellingham. Burlington, with a population of 1300, is 24 miles south of Bellingham. Mount Vernon, whose population is 2400, is 4 miles south of Burlington. Sedro-Woolley has a population of 2100 and is five miles east of Burlington. Concrete has a population of 1200 and is 28 miles east of Burlington. Glacier, with a population of 100, and Maple Falls, with a population of 500, are 8 miles south of the international boundary line and are respectively 8 and 15 miles from Nooksack Falls.

There are three sources of power for this system: Nooksack Falls development, York Street steam station and the Western Canada Power Company.

NOOKSACK FALLS DEVELOPMENT

The Nooksack Falls development is located on the right bank of the north fork of the Nooksack River in Whatcom County, Wash., and is approximately 8 miles in a southeasterly direction from the town of Glacier on the Bellingham Bay & British Columbia Railway. This development is in the United States Washington Forest Reserve. The Nooksack River rises in the Cascades on the north side of Mount Baker and the flow in dry weather is principally from glaciers. The average flow of the river is about 250 second feet, and the area of the water shed is supposed to be from 100 to 110 square miles.

DAM AND HEAD WORKS

The dam is located about 80 ft. above Nooksack Falls, which has a drop of 110 ft. The dam consists of a log 4 ft. in diameter, thrown across the stream to divert the water into the intake. The ends of this log are anchored to the steep rock banks of the river by concrete piers. The upper and lower sides of the dam are sheathed and cribbed with loose rock in the center. The intake was excavated out of

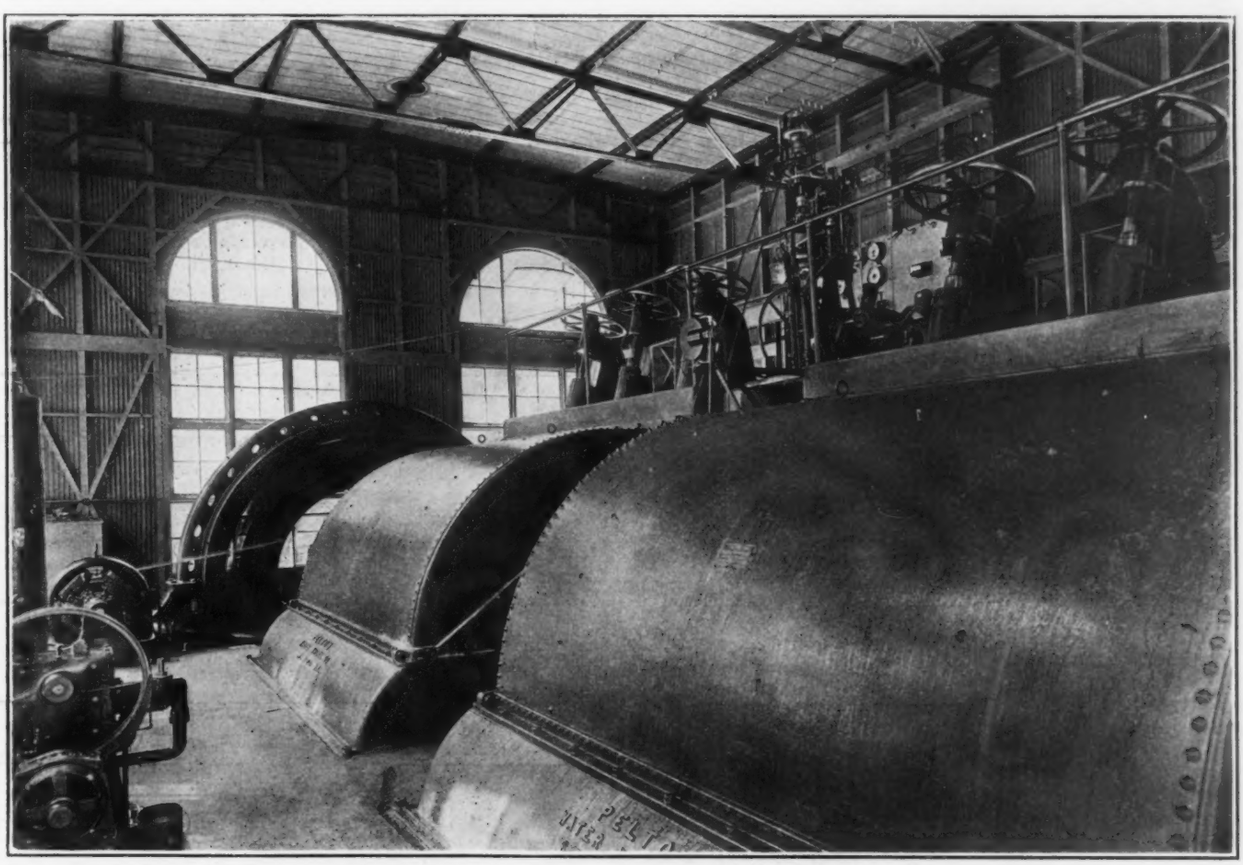


Fig. 1—Generating Room of the Nooksack Falls Station.

solid rock and consists of two concrete walls about 2 ft. thick, 18 ft. long and 16 ft. deep, holding in position a wooden frame for two 3½ in. thick by 4 ft. wide gates, operated through a set of gears by a motor supplied with energy and controlled from the power house. At times of high water, trees, bushes and other rubbish come down the river, and in order to keep this debris from entering the system, the intake is supplied with a grid consisting of ten 56-lb. T-rails, 18 ft. long and held in place by ¾-in. iron stirrups, bolted through 10 in. by 10 in. timbers across the entrance.

FOREBAY AND PENSTOCK.

Water from the intake enters the forebay through a rock tunnel, 8 ft. by 10 ft. by 260 ft. long, which is lined with 2-in. plank. The forebay is 12 ft. by 60 ft. by 22 ft. deep, is constructed of timber, 8-in. by 8-in. posts and 8-in. by 10-in. sills being used. The sides and bottom are 2.5-in. by 12-in tongued and grooved plank, spiked to the posts. The excavation for the forebay is made entirely in solid rock. Attached to the forebay is a spillway, 42 ft. long, consisting of 6-in. by 6-in. fir posts and 2.5-in. by 12-in. plank sides and bottom, by means of which the sand and other sediment is dumped directly into the Nooksack River below the Falls.

The penstock pipes consist of one 24-in. wood-stave pipe (2-in. by 6-in. stave) and ⅝-in. iron bands with steel riveted elbows at curves, and one 47-in. diameter steel riveted pipe 0.203 in. thick. The pipes lie along a uniform grade of approximately 12 per cent, the hillside sloping transversely about 40 deg. from the horizontal. The total head from the water in the forebay to the power house is 176 ft. The capacity of the 47-in. pipe is 172 second ft. and that of the 44-in. pipe is 149 second ft., and the velocity is 16 ft. a second. The total length of each pipe line is 1380 ft., in which distance there are four tunnels of 196-ft., 28-ft., 79-ft. and 80-ft. lengths. At the lower end of the 47-in. pipe a 30-in. stand pipe, 250 ft. long and ⅞ in. thick, was erected, which terminated at a point above the level of the intake, so as to act as a safety valve in case of sudden closure of the valves to the water-wheel. At present, however, this stand pipe is not in use, having been found to be unnecessary. The pipe lines are anchored to the hillsides at bends and intermediate places by being imbedded in concrete blocks fastened to the rock. Because of several rock slides and consequent bursting of pipes, protecting walls have been built into the hillsides to prevent these rock slides. From the power house to the forebay a walk made of 2-in. by 12-in. plank, with railing at dangerous places, follows the pipe lines up the canyon side.

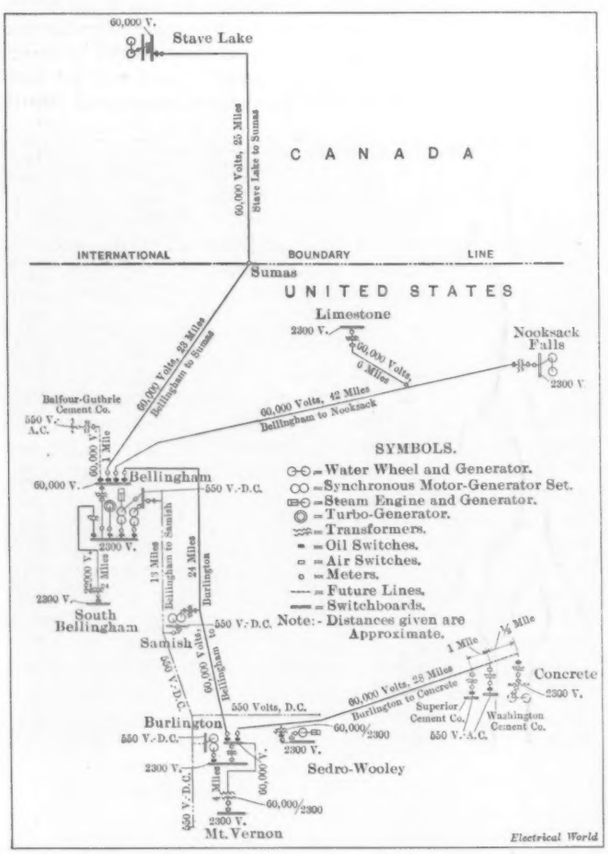


Fig. 2—Diagrammatic Map of Distribution System.

Fig. 3—Penstock Above Nooksack Station.

BUILDINGS.

The power plant building is 40 ft. by 60 ft. by 29 ft. high, with concrete floor and three concrete walls, the fourth wall being of corrugated iron on wood frame. The roof is supported on a steel frame and is built of wood plank covered with tar and gravel. A tail race consisting of two concrete walls controls the spent water from the wheel.

The transformer house is located on the hillside, 150 ft. above the power house. It is 24 ft. by 22 ft. by 17 ft. high and has concrete walls and floor, and plank roof covered with tar and gravel.

The chief operator's house is a two-story frame dwelling, with woodshed attached. There are three other one-story, five-room cottages occupied by the operators. The other buildings around the plant are board sheds with the exception of the stable, which is a frame building and painted. At the town of Glacier there is a patrolman's frame dwelling and also a stable.

EQUIPMENT.

The power plant is equipped with a six-runner, horizontal, tangential, 3200-hp, Pelton water-wheel, which runs at 200 r.p.m. A type-Q Lombard governor controls the speed of this wheel. Direct connected to the shaft of this water-wheel is a 1500-kw, Westinghouse, revolving-field, 2200-volt, three-phase, 60-cycle alternator. A 45-kw, Westinghouse, 125-volt, 850-r.p.m. exciter supplies the energy for the generator field, plant lamps, motor-operating head gates and motor operating the water-wheel valves in the station. In addition to this is a motor-generator set of 14 kw rating, which supplies energy for lighting and 125-volt energy when the Nooksack station is not in operation and when energy is being transmitted from the York Street station in Bellingham. A 20-ton hand-operated traveling crane made by the Northern Engineering Works, of Detroit, Mich., is used whenever machinery is taken apart or repaired. One double Lombard oil pump with vertical tank, operated by a 5-hp motor, supplies the oil for the water-wheel governor.

In the concrete transformer house are three 500-kw Gen-

eral Electric 2300 to 60,000-volt, oil-insulated, water-cooled transformers, with three Westinghouse single-pole, 60-cycle, 46-amp static interrupters connected on the high-tension side of the transformers.

TRANSMISSION.

From this transformer house energy is transmitted over a

Fig. 4—Intake for the Nooksack Station.

three-phase, 60-000-volt, single-pole line to Bellingham, a distance of 42 miles. The poles are placed 150 ft. apart and are of red cedar with an average length of 45 ft., with a minimum top diameter of 9½ in. and a minimum bottom diameter of 15 in. Poles are braced at all curves, river and railway crossings. On the first 8 miles from the power house, through the Forest Reserve, the poles are set in rock, the remaining poles being set in hard pan and earth. The poles at river and railway crossings are 60 ft. long and at river crossings are set in log cribs, 12 ft. x 12 ft., filled with rock.

The cross-arms are of fir, with two bolts at each pin hole to prevent splitting of the arm. The arms are painted with red lead and oil and double arms are used at all brace poles and transpositions. The insulators are of Locke, 60,000-volt, high-tension porcelain, cemented to galvanized pins. They are of the four-petticoat type, with a diameter of 14 in. and a height of 12½ in. The transmission cable throughout is a seven-strand, aluminum wire, with a conductivity nearly equal to that of No. 1 copper. Tie wire is No. 2 solid aluminum and about 3 ft. long at each tie. This line was designed to transmit 6000 kw at 55,000 volts. With a transmission tension of 38,000 volts the records taken from August, 1908, to August, 1911, show the transmission and transformer losses to be 10.8 per cent. The line is transposed every 3 miles and terminates at the York Street station in Bellingham, Wash.

TELEPHONE LINES.

The main telephone line is strung on the poles of the high-tension line, 10 ft. below the high-tension cross-arms. Cross-arms are of fir (painted), with two galvanized iron braces to each arm, and are double at the same places as high-tension arms, as well as at transpositions, which are made at every tenth pole. The pins are of locust and the insulators are of glass. The wire is No. 10 B. & S. gauge, hard-drawn copper. There are eleven 2500-ohm Stromberg-Carlson magneto telephones in use, each protected against breaks in the high-tension line by a General Electric high-tension 1 to 1 ratio telephone protective transformer with adjustable spark-gap discharge to ground.

DISTRIBUTING SYSTEM.

Around the power plant at Nooksack and along the penstock is a small 125-volt distributing system for lighting the station and operators' cottages, and also for operating the gates at the intake. This line consists principally of No. 6 weatherproof copper wire carried on glass insulators supported by locust pins in cross-arms bolted to wrought-iron pipe posts 10 ft. long and set in the rock.

At Glacier and Maple Falls the voltage is stepped down for lighting purposes by a 10-kw transformer at Glacier and by a 25-kw transformer at Maple Falls.

A 5½-mile transmission spur runs to Limestone, at which point there are installed three 100-kw, 60,000 to 2300-volt, oil-insulated, self-cooled transformers, controlled by a pole top disconnecting switch outside a wood frame transformer house.

Twenty-three-hundred-volt energy is taken through three No. 0 copper wires, 300 ft. to two 50-kw, 2300-volt to 440-volt pole-type transformers, located just outside the plant of the International Line Company, which has a quarry 1000 ft. up the hillside and manufactures a high grade of hydrated lime, using electric drive in the process of manufacture.

WESTERN CANADA POWER COMPANY.

The Western Canada Power Company, as the name implies, is in western Canada, 35 miles from the city of Vancouver and 18 miles north of the international boundary line between Canada and the United States. This development will have an ultimate capacity of 100,000 hp, although at present it furnishes only one quarter of that amount. Stave Lake, which is 9 miles long with an average width of 1 mile, and 7 miles of river furnish the water at a hydrostatic head of 105 ft. Six 3000-kva, 4000 to 60,000-

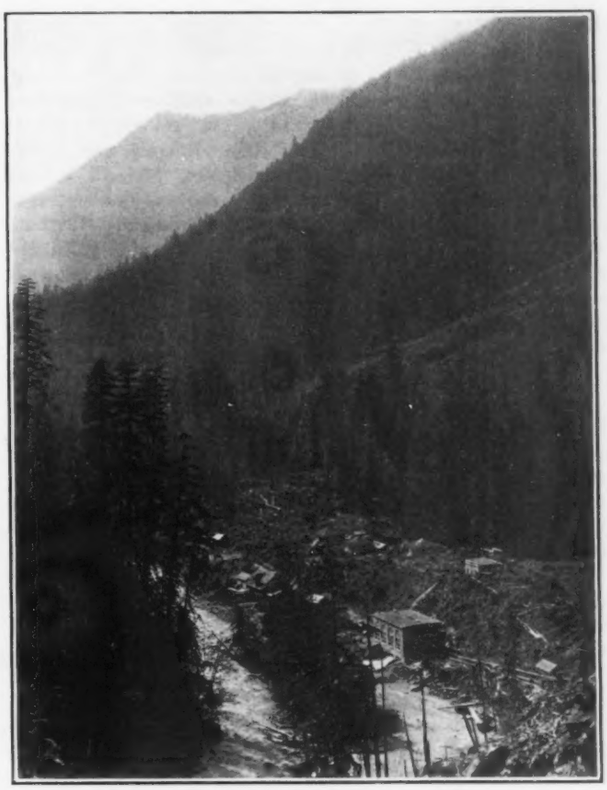


Fig. 5—Power House and Penstock at Nooksack Falls.

volt, step-up transformers are used for increasing the voltage for transmission purposes. A 35-mile steel-tower double line runs to Vancouver, and an 18-mile, wood-pole double line runs to Sumas, which is on the boundary line. At this point the Whatcom County Railway & Light Company has contracted for the purchase of power in blocks up to 5000 kw.

YORK STREET STATION.

The York Street Station of the Whatcom County Railway & Light Company is located at the corner of York Street and Railroad Avenue in Bellingham. The ground on which the station is located is in the shape of an irregular "L," being bounded on the north by Whatcom Creek, on the south by York Street, on the east by the Northern

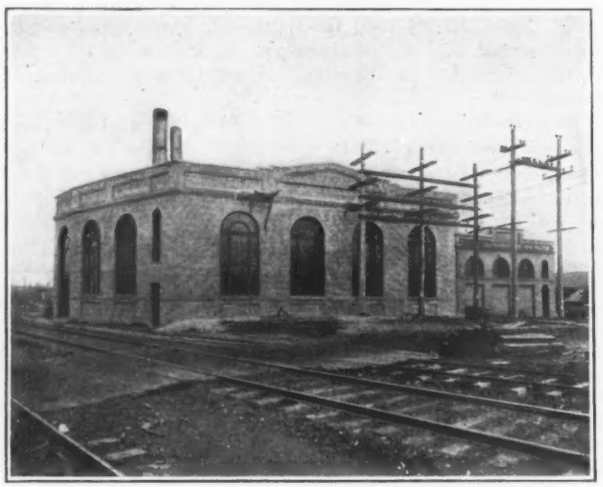


Fig. 6—York Street Station.

Pacific Railway right-of-way and on the west by Railroad Avenue and the Bellingham Bay & British Columbia Railway.

The plant acts as a relay and substation, and is made up in three sections. The boiler and engine rooms run north and south in length and are parallel to Railroad Avenue, on which is located the side track where fuel oil, wood, etc., are received at the plant. Near this side track and 120 ft. north of the boiler room is the concrete fuel oil storage tank. About 30 ft. east of the engine room is the rectangular repair shop, bordering on York Street and the Northern Pacific Railway right-of-way. About 100 ft. from the north end of the shop and 100 ft. from the northeast corner of the engine-room is the stable and carriage shed. Back of all these buildings which front on York Street is Whatcom Creek.

BUILDINGS.

The boiler room is about 88 ft. by 45 ft. by 26 ft. high, and is made of corrugated galvanized iron on steel frame with concrete floor. The roof is nearly flat and is constructed of reinforced concrete covered with tar and gravel and supported on a steel frame. Twenty windows make the boiler room amply light by day and thirty-three 60-watt tungsten lamps with prismatic glass shades supply light at night. The construction of the building allows of expansion by moving the west wall so that four batteries of two boilers each can be installed, with a minimum amount of changes.

The turbine room is 83 ft. 9 in. by 87 ft. 5 in. by 75 ft. 4 in. by 65 ft. outside dimensions respectively on the north, east, south and west sides. The building has a basement 14 ft. deep and a single story of 28 ft. maximum height above ground level, making a total height from the basement floor to the top of the roof, exclusive of skylight, of 42 ft. That part of the basement which is occupied by machinery, such as feed-water and circulating pumps, has a concrete floor. The main floor of the station is of steel and reinforced concrete construction, in which is inserted conduits for electric wiring. Such wiring as cannot go in conduit in the floor is supported under the switchboard by means of steel racks. Seven large windows and a large door with windows above it supply light to the station by day and thirty-five 100-watt tungsten lamps by night.

The engine room is 100 ft. 6 in. by 38 ft. by 22 ft. to the highest part of the roof. The floor is of concrete and painted to give a better surface to keep clean and make less dust. A 17-ft. by 18-ft. basement, 12 ft. 6 in. below the main floor is furnished with a concrete floor. This basement is lighted by four 16-cp carbon lamps.

The fuel oil tank is 30 ft. by 20 ft. by 10 ft. deep and holds about 40,000 gal. of oil. It is made of 12 in concrete on sides and bottom reinforced with ½-in. round iron bars 12 in. on centers, and has a 5-in. frame concrete top reinforced with ½-in. round iron bars 6 in. on centers lengthways and 12 in. on centers crossways. There are two openings in the top, which permit of filling the tank and inspection. A coil of pipe, through which exhaust steam from the pump passes, lays along the sides of this tank and keeps the oil warm and consequently thin. This oil is about as thick as thin molasses. The tank is below the level of the earth on three sides, being open to the creek on the other side.

The repair shop is about 48 ft. by 20 ft. by 14 ft. to the eaves and is of wood frame construction with shingle roof. Attached to this is a 10-ft. by 20-ft. shed used as a storeroom for line material and supplies. The shop is used for all repairs excepting those made on car bodies and trucks. Power is furnished to the machinery by two 220-volt motors.

FUEL.

York Street station operates as a substation most of the time, but occasionally has to act as a generating station when the power fails from other sources. At these times standard California fuel oil obtained from "Baker," "Colinga" and "Sunset" oil fields is used. This oil has a higher flash point than crude oil, because it has had all the volatile ingredients removed. The oil is pumped from the fuel tank outside by two Wagner duplex pumps and is forced at 120 lb. pressure through a heater inside the boiler room consisting of return coils of steam and oil pipes incased in a 12-in. cast-iron pipe covered with steam covering. The pumps are conveniently located about 15 ft. in front of the boilers. From this heater the oil goes to the boilers where it is burned, after being sprayed through home-made nozzles. The nozzles consist of ⅜-in. pipe

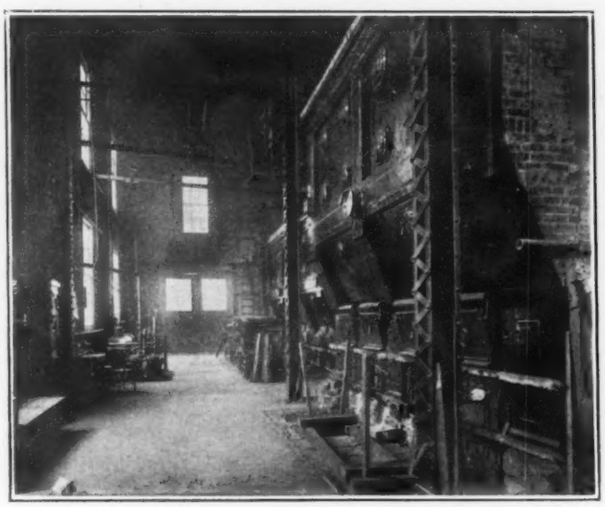


Fig. 7—Boiler Room, York Street Station.

with controlling valves from 1½-in. supply mains leading into a 1-in. pipe used as a mixing chamber and containing a 1-in. wood auger bit to aid in the complete breaking up of the oil. On the end of this 1-in. pipe is a 1½-in. by 1-in. reducing elbow, plugged on the 1½-in. end and turned up with a horizontal slot 1½ in. by 3/32 in. in the elbow, made with two hack-saw blades in a frame together. On the two

middle of the four burners this slot is sawed in the middle of the front of the elbow, but on each of the end burners the slot is sawed to one side so that the flame will not impinge against the side walls. A nozzle is thrust through each of the four lower doors of the boiler so that they extend just inside the front wall. The grate is covered with a layer of firebrick with the exception of a space 18 in. by 15 in., through which the hot-air supply is fed directly under each burner. The air is led from the front of the boiler through tile to the back of the grate where it is heated in returning to the open hole at the front of the grate. The firebrick covering of the grate is made in the form of a spiral curve, beginning 6 in. below the nozzle of the burner and curving up as it goes towards the back of the boiler and tubes, so that when the flame leaves the firebrick cover it is directed up through the tubes, rather than directly against the bottom of these. The flame from the burners spreads out like a fan and fills nearly the whole combustion chamber.

BOILERS AND AUXILIARIES.

The steam generating units consist of a battery of two 500-hp Stirling water-tube boilers and one single 500-hp Stirling water-tube boiler, supported on reinforced concrete foundations. If more boiler capacity is needed it is planned to add another 500 hp unit to the single one making a battery of two, and if further enlargement is necessary four more boilers can be placed facing these, as has been mentioned. A stack 69 ft. 9 in. high above the tops of the boilers and 7 ft. in diameter of 3/16 in. average plate thickness furnishes the necessary draft for the battery of two boilers, while the single boiler is equipped with a shorter stack 5 ft. in diameter.

The boilers are supplied with two No. 4 Spencer damper regulators. Attached to these regulators are rods operating valves which control the amount of steam and oil supplied to the fuel lines on the fronts of the boilers, so that the fires are automatically regulated for a constant pressure of 150 lb. of steam.

Feed water is supplied from the creek in the rear of the station through a Wainwright even-flow water heater by two Warren duplex pumps set in cast-iron drip pans on

Fig. 8—Interior View of Turbine Room, York Street Station.

heavy foundations. Feed-water heater and pumps are located in the basement of the turbine room.

PIPING.

Steam piping is of the latest pattern and capable of standing 250 lb. pressure, although the pressure carried is only about 150 lb. All supply pipes are completely covered with asbestos and canvas.

TURBINE AND EXCITER.

On the ground floor of the turbine room in the northeast part is located the turbo-alternator. This machine is a unit consisting of a four-stage, Curtis, horizontal type, 150-lb., 2000-kw, 1800-r.p.m. turbine, run condensing, and a direct-connected General Electric 2000-kw, 2300-volt, 60-cycle alternator.

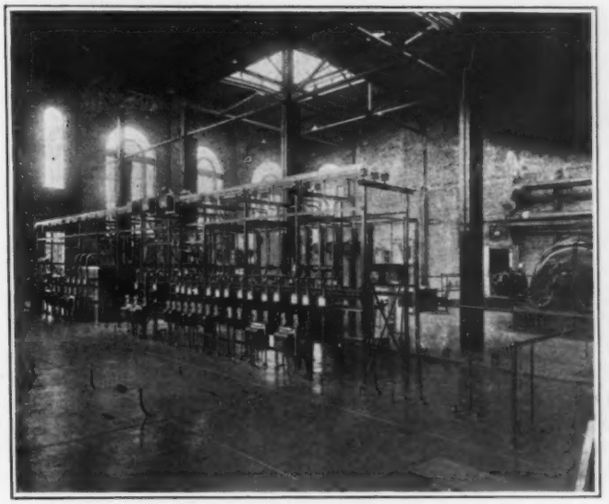


Fig. 9—Rear of Switchboard, York Street Station.

The turbine exciter is a separate Curtis turbine-driven, non-condensing unit running at 3600 r.p.m. The generator is rated at 35 kw and 125 volts.

ENGINE.

The only steam engine in the plant is a Hamilton-Corliss 1000 hp cross-compound unit, running at 150 r.p.m., made by the Hooven, Owens, Rentschler Company, of Hamilton, Ohio. This engine runs either condensing or non-condensing, and connected to it by a four-ply leather belt 75 ft. long and 6 ft. wide is a pulley which can be connected by means of a clutch to a 500-kw motor-generator set.

CONDENSERS AND PUMPS.

The turbine condenser is a 57-in., Helander patent, cast-iron, barometric condenser, mounted in the rear of the turbine room outside the station. The hotwell is a cylindrical tank 8 ft. by 8 ft. by 3 in. in diameter with a 4-ft. by 1-ft. outlet discharging into a flume. In conjunction with this condenser is a dry vacuum pump located in the northeast corner of the turbine room, a circulating pump and a 12-in. volute pump located in the basement. All three of these pumps were furnished by the Alberger Condenser Company. The engine condenser equipment is somewhat similar to that on the turbine.

The flume which carries off the hot water discharged from the condensers is made of 2-in. plank, 200 ft. long, 2 ft. 6 in. deep and 4 ft. high. Cooling water for the condensers and machines and feed water for the boilers is taken from the creek when it is not too dirty. In times of high water the creek is unusually dirty, and then water from the city mains is used from an 8-in. supply pipe. All water from the creek is taken from an intake made of 6-in. by 12-in. plank, 10 ft. by 13 ft. by 15 in. deep. Down the front is an opening 8 ft. 10½ in. wide covered with a grid of ¼-in. by 3-in. bars with ¼-in. spaces. This grid keeps large foreign matter from the system, which is further protected by two iron plates 3 ft. back of this grid. These plates are 5 ft. 9 in. by 5 ft. and have 8200 ⅜-in. holes drilled in them on ¾-in. centers. The plates slide in grooves which allow of their being raised and cleaned.

MOTOR GENERATORS.

Two motor-generator sets are located near the trans-

former cells in the south end of the engine room. These are 500-kw General Electric machines, the generators being wound for 600-volt direct-current and the synchronous motors for 2300 volts, 60 cycles. These machines supply direct current to the 23 miles of city railway lines and part of that used by the 33-mile interurban line running between Bellingham and Mount Vernon and Sedro-Woolley. One motor generator can be connected by a clutch to the 1000-hp Corliss engine and both units run as generators, but this is very seldom done.

TRANSFORMERS.

In the three cells at the south end of the engine room are three 500-kw, 60-000 to 2300-volt, General Electric, oil-insulated, water-cooled, 60-cycle transformers. On two of the secondary windings of these transformers are connected booster transformers of 50 kw capacity for the adjustment of the voltage received at the York Street station.

SWITCHBOARD AND RACKS.

The switchboard and racks are in the southern part of the turbine room and extend nearly across the south end. Directly back of the panels is an open space through the floor about 8 in. wide, through which the heavy cables pass to angle iron racks in the basement where they are supported on heavy glass insulators and lead to the various units. About 4 ft. 6 in. in the rear (south) of the panels is an angle iron rack running the length of the switchboard and 4 ft. by 8 ft. 6 in. high. This rack supports the hand-operated oil switches, instrument transformers and single bus line, room for another busbar line being provided. All 2300-volt apparatus is located on the angle-iron racks. The bus line is divided in the middle so that one end is a generating bus and the other is the distributing bus. Two series transformers join these two sections and through these the total energy distributed from the station is measured.

All circuit breakers and main panel switches on the board are connected with a bell alarm system, which closes the circuit and rings electric gongs whenever a switch goes out.

DISTRIBUTION SYSTEM.

Primary distribution is done at 2200 volts, and the poles have an average height of 40 ft. with a top diameter of 8 in. Primary and arc insulators are of porcelain while the secondary insulators are of glass. This aids the linemen in their work, as each wire is immediately identified by the insulator and position on the arm.

The north side of the city is supplied from York Street and is divided into four districts: Three single-phase light districts for residences and one three-phase light district for the business section. No. 0 feeders are run from the panels in the station to the electrical centers of the lighting districts. A future installation will include feeder voltage regulators so that a constant voltage can be kept at the centers of these lighting districts. Three-phase mains are carried about the city so that there are only a few motors on the lighting mains, and these motors are of small size. No. 4 and 6 wire is used for primary distribution from the feeder ends.

Multiple arc lighting is done at 104 volts, 20 to 1 ratio transformers of 1.5 to 25 kw rating being used. All transformers are provided with suitably fused cut-outs and grounded on one side of the secondary. In the residential sections, secondary circuits are made, having one transformer usually, with No. 4 or No. 6 secondary wire running not more than 1000 ft. from the transformer in any direction. If the section is very thickly settled and the load is heavy, sometimes two transformers are connected in multiple on the same circuit. In residential districts transformers are given connected loads up to three times their rated capacity and are fused for 66 per cent overload. In outlying sections of two districts transformers have been installed to boost the voltage for better service. In business districts transformers are given a connected load of one and a half times their rated capacity and fused for 45 per cent overload. Transformers feeding motor circuits are given a connected load 25 per cent greater than their rated capacity and fused for 100 per cent overload.

SOUTH BELLINGHAM SUBSTATION.

On Elk Street, in the northeast part of the Gas Works property is located the south side substation. It is 16 ft. by 16 ft. by 12 ft. high inside dimensions with an addition 16 ft. by 7 ft. by 5 ft. on top, where the high voltage wires enter through 36-in. sewer pipes. The walls are of brick, the floor is concrete and the roof is wood covered with tar paper and tar and gravel. Power is brought at 23,000 volts from York Street station through three 100-kw Stanley, oil-insulated, water-cooled, 2300 to 23,000-volt transformers by three No. 4 copper wires 5 ft. apart on 60 ft. poles.

The substation equipment consists of three 100-kw Stanley, oil-insulated, water-cooled, 23,000 to 2300-volt transformers and a wood frame switchboard, supporting four oil switches mounted on the back of the board, three ammeters, one voltmeter, three series transformers, two shunt transformers, a watt-hour meter showing the energy distributed by the station and a 100-amp Wright maximum-demand meter showing the maximum load. No attendant is kept at this station, but every other day the meters are read and the transformers are inspected.

The primary and secondary distribution are similar to that of the north side from York Street station, excepting that the single-phase light districts do not each have a separate switch. Arc lighting is done by a multiple system having one primary wire controlled by a switch in the station and run in conjunction with one light wire. Separate transformers of small capacity have been installed where necessary and have from one to four arc lamps connected to them. The controlling switch is operated by one of the gas makers when the arcs are connected or disconnected. The transformers, etc., are similar to those on the north side, excepting that the secondary voltage is 115 volts on account of the longer circuits necessary in the sparsely settled districts.

The Whatcom County Railway & Light Company is operated by the Stone & Webster Management Association. Mr. L. R. Coffin is the local manager at Bellingham.

INCREASE IN BOILER ECONOMY THROUGH NOVEL BAFFLING.

As already briefly noted in these columns, experiments with a novel and improved arrangement of baffling in some of the 511-hp Stirling boilers at the Delray station of the

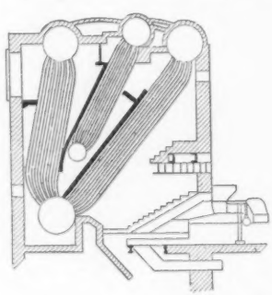
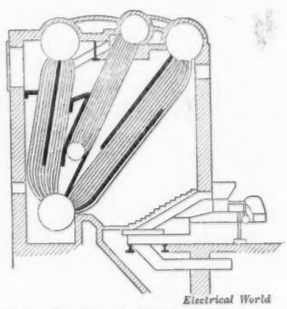


Fig. 1—No. 5 Boiler with Original Baffling.



Electrical World

Fig. 2—No. 6 Boiler with Improved Baffling.

Detroit Edison Company secure an additional pass for the hot gases, raising the efficiency of these units to values practically equivalent to those secured with the huge nominal 2365-hp boilers in the same station, described in the *Electrical World* of Dec. 16 and 23, 1911. The tests reported have been carried out on boiler No. 6 in power house No. 1, which contains twenty-four of the smaller units. The im-

proved construction, which was devised by the local engineering staff, will be extended to these 511-hp boilers, and probably also to the 2365-hp double-fired units, in the effort to increase the latter's economy even above their present record performance of 80 per cent efficiency near nominal rating, the theoretical limit of efficiency being 89 per cent.

Comparison of the methods of arranging the baffles is

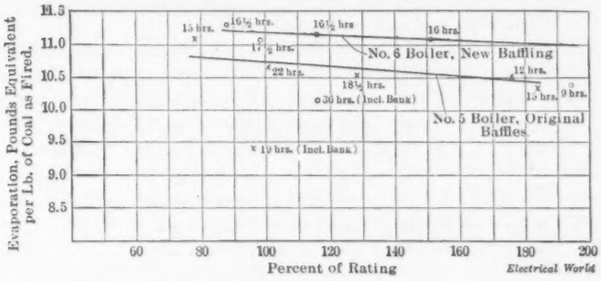


Fig. 3—Curves Showing Equivalent Evaporation for Various Ratings.

afforded by the accompanying sketches, Figs. 1 and 2. With the improved construction, a downward direction is substituted for the up-flow in the original first pass, at the same time affording a larger combustion chamber over the grates. The new middle pass then becomes vertical instead of the down sweep formerly used, while for the final nest of tubes a complete double pass is provided instead of the usual up-flow. The result has been a further extraction of heat units from the flue gases as shown by the curves in Fig. 3. The upper curve represents the performance of the No. 6 unit, while below for comparison there is plotted the performance of boiler No. 5, with the original arrangement of baffling.

SYNCHRONOUS MOTOR PERFORMANCE.

Methods for Determining the Performance Without Resort to Complicated Diagrams or Equations While Avoiding Major Errors.

BY NICHOLAS STAHL.

THE increasing use of synchronous motors is largely due to improved methods for securing to the machine its normal function; that is, carrying its appointed load at its synchronous speed. This increased use demands improved starting devices and greater starting torque and pull-in torque.

The older machines at starting drew heavy currents from the lines at low power-factors, giving rise to large voltage disturbances due both to the current itself and to the low power-factor; in addition, the latter, with its demagnetizing effect upon the fields of the generating apparatus, involved the hazard (and in many cases the actuality) of such a drop in voltage at the power station as to prevent the incoming machine from locking into synchronism or as to cause motors already heavily loaded to stall.

This difficulty has been obviated in two ways, first, by the use of auto-transformers or compensators, with suitable switch gear, which permitted a reduction of the kva taken from the line to nearly normal throughout the starting stages, and, second, by improvement in the form of dampers on the field poles, by the adoption of a form similar to the "squirrel-cage" type of induction motor, by which not only are higher starting and pull-in torques secured but the function of "hunting" prevention decidedly improved. For specially heavy starting torques a motor has been designed having the field winding distributed like a phase-wound induction motor secondary and starting with this winding closed through a resistor of high resistance; after synchronism is nearly reached, the unidirectional current is supplied to the field coils, and the motor locks into step.

Further, there has opened up comparatively recently a decided field for the introduction of the over-excited synchronous motor for power-factor-correction purposes, with the machine either floating idly on the line, in the popular rôle of a "synchronous condenser," or carrying various percentages of its rated capacity in kva in kilowatt capacity, either directly as a mechanical load or as the driving end of a motor-generator set.

Be it noted once more, in passing, that the application of the term "condenser" to such a machine is justified solely by its property of drawing leading current from the line; in other respects, as has been remarked editorially as well as otherwise in these columns, it differs markedly in every particular from its stationary prototype.

Various graphical methods have been published for the rapid calculation of the corrective effect of such over-excited machines by the supply to the system of wattless kva opposite in phase (and hence, graphically, opposite in direction) to the wattless kva of the system arising from a lagging power-factor. In many cases it has seemed as though too little stress had been laid upon the beneficial effect of these motors (or other apparatus, like rotary converters) when operating merely at 100 per cent power-

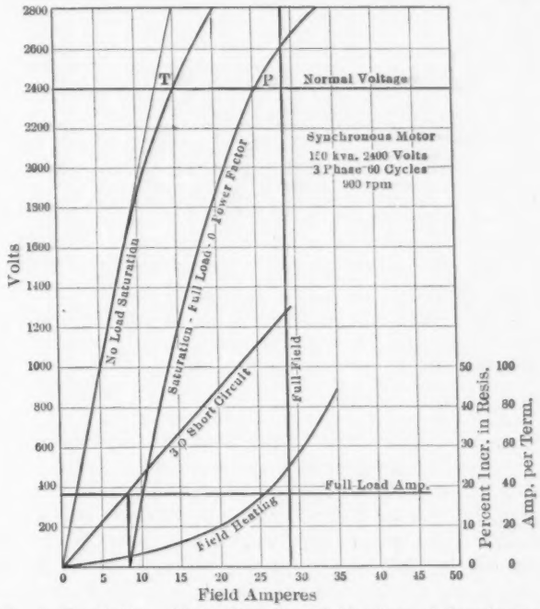


Fig. 1—Excitation, Short-Circuit and Heating of Synchronous Motor.

factor, on the principle of the "method of mixtures"; that is, adding so much of good to so much of bad to obtain a better average.*

Most of these methods have, for the sake of simplicity, assumed that the kva input of the motor remained constant and that the full-load losses of the machine did not prevent zero-power-factor operation. Or it has been assumed that where a change was to be made in the kilowatt load of the machine the field excitation would be altered so as to keep constant either the kva input or the power-factor of the machine; also to discuss the effect on power-factor and kva of a change in the applied voltage has seemed to introduce too much complexity. Even in those places where a full graphical discussion has been given, it has been customary to base the construction on data involving a knowledge of the inherent reactance of the machine, as well as its resistance, and to assume that these quantities remained constant throughout the range of operation.

The calculation of these quantities, however, is seldom

*In the *Electric Journal* for October, 1911, the writer presented curves allowing a ready calculation of this effect.

simple; resistance depends upon heating directly, it is true, but this latter upon the ventilation, which latter at best requires considerable knowledge of the properties of machines. The reactance effect depends not only on the kind of iron in the magnetic circuit, its permeability, saturation and temperature, but upon the decreased leakage with increased saturation. Below is given a method of calculating graphically the performance of such machines, sufficiently accurate to take all necessary practical account of these effects and requiring only such experimental data as may readily be obtained by the average operator.

These data are four: (a) The no-load saturation curve; (b) the synchronous impedance line, found by plotting field amperes (or, in terms of the no-load saturation, terminal volts) required to circulate various currents through the short-circuited armature; (c) the curve for percentage increase in field resistance with increase in field current—a single experimental point suffices, since the field circuit heating curve is a parabola passing through the origin and the experimental point; (d) the full-load, zero-per-cent power-factor saturation curve, found by placing two machines on the circuit and overexciting one machine and underexciting the other until the desired current circulates between them. Then the terminal voltage may be plotted against the exciting field amperes. These results are plotted as shown in Fig. 1. It is, however, often possible to secure such curves directly from the manufacturer.

Various methods have been proposed by which the full-load, zero-per-cent-power-factor curve might be constructed from the no-load saturation; while considerable accuracy can be secured with certain machines, with others of high speeds and reactance the discrepancies are so great as to render more dependable and more easy the results of direct test since certain points of the full-load, zero-power-factor curve are always taken in any case.

Mention should be made of the method urged by Mr. B. A. Behrend in the A. I. E. E. *Transactions* for June, 1903, in protest against the existing methods for the pre-calculation of full-load, zero-power-factor regulation curves of alternators and in defense of the general proposition that an exact pre-calculation involved at best so many empirical constants regarding leakage constants of embedded and end-turn conductors and of the field windings as to allow only the skilled designer to make more than a fair approximation. The methods then in vogue were, first, that propounded in 1891 by Behn-Eschenburg giving results called by Behrend the "pessimistic" curve, and based on the derivation of the full-load, zero-power-factor curve by subtracting along the voltage axis from the no-load saturation, at every point, the quotient of normal volts by the short-circuit amperes flowing at normal excitation. The term "pessimistic" was used since the curve resulting from test invariably lay above the pre-calculated one, but much closer to it than to the "optimistic" curve or the A. I. E. E. standard, which consisted in displacing horizontally to the right the no-load saturation by an amount equal to the field amperes required to circulate full-load amperes, with the armature short-circuited. A machine so pre-calculated had values on test below those presumed, and hence had worse regulation than was anticipated. It was Behrend's further contention that it was simple and much more accurate to run a full-load, zero-power-factor saturation curve on test since a no-load saturation would be run anyway for the purposes of test, and the experienced designer would have been able to proportion his machine so as to secure results safely within his guarantees.

The present standardization rules of the A. I. E. E. prescribe a procedure for determining regulation along the lines of Behrend's contention. At all events, it is now general practice to run a full-load, zero-power-factor saturation test, and even in the case of an operator of a synchronous motor remote from its generator it would not be difficult in most cases to arrange, by telephone or otherwise, at times when the machines were free, for such respective underexcitation and overexcitation as would be necessary to the location of one or more (preferably as many as possible) points, since two, accurately determined, would suffice and one is always known from the fact that the curve crosses the field ampere axis at the point indicating the field amperes necessary to circulate full-load on short-circuit.

On such actual tests of machines is based the following method of investigating the behavior of a synchronous motor under various conditions of excitation, power-factor (lagging or leading) and total kilowatt input.

From Fig. 1 is to be obtained the short-circuit current for normal voltage excitation as a percentage of the full-load current. The corresponding kilowatt's value is to be laid off on the kilowatt axis. An arc is to be swung toward the base line until it meets a horizontal line from a point corresponding to the resistance losses at the short-circuit current just determined. This intersection, C, (Fig. 2), is the center of the circular current locus of the armature current, the magnitude of which is represented by the distance from P to any point on the circle. Moreover, CP corresponds to normal excitation, or 100 per cent counter emf; other percentages of counter emfs may be represented proportionally along the line CP, after which circles drawn with C as the center and a given percentage of counter emf as the radius determine the corresponding current loci.

A suitable power-factor circle being drawn such that intercepts on the vertical axis represent power-factors, the behavior may be investigated as follows: Assume an excitation corresponding to 50 per cent counter emf and a total load (including all losses) equal to 75 kw. A horizontal line is drawn to meet the 50 per cent counter emf circle at Q'; $Q'P$ will be the current which may be read directly in amperes by projection on the appropriate vertical axis; the power-factor is found as 42 per cent by continuing PQ' to the power-factor circle at F. Moreover, with a circle from Q' to the line CP at L', the horizontal from L' read at A gives the armature copper loss at PA, or, say, 7 kw.

The field excitation in amperes may be determined at once from Fig. 1 by running a horizontal to the no-load saturation from the 50 per cent normal voltage point and then down to the base line.

The foregoing has been based on the assumption that the short-circuit curve remains a straight line, which will be true within the limits of safe armature heating. Moreover, it has been supposed that the applied voltage is constant and the excitation was varied. Should the line voltage vary, the excitation being unchanged, it is necessary merely to consider the excitation as varied in the reverse direction; for example, if the line voltage were varied from 2000 to 2200, with a motor counter emf of 1600, the first condition represented $\frac{1600}{2000}$, or 80 per cent counter emf, and the second $\frac{1600}{2200}$, or 72.7 per cent; hence, a new circular current locus is drawn for 72.7 per cent excitation and the armature current, power-factor and armature copper losses are redetermined assuming a certain kilowatt load on the machine.

To separate the external load from the total, the iron losses, friction and windage and field circuit copper loss must be subtracted as well as the armature copper. Friction and windage are constant in a synchronous machine and may be found (if necessary) once for all. Iron loss and field-circuit copper loss must also be separately determined, but for the purposes of such accuracy as is usually required in practice they may well be lumped at from 3 to 5 per cent of the normal rating in kilowatts, depending on the size of the machine.

From the foregoing it will be seen that the current in

the armature of a synchronous motor of constant excitation and constant applied voltage is determined by the length of a line from a fixed point to a variable point on the arc of a certain circle, which is one of the long-known circular current loci of the synchronous motor.

That such loci exist is clear from the consideration that the current equals the driving emf divided by the impedance, assuming that the latter constant, the driving emf, is, vectorially, the length of a line, one end of which is fixed at the end of the generator voltage and the other end of which terminates at the end of the motor counter emf, which sweeps out a circle as the load varies (or the phase angle between the machines changes), so that, in turn, the current line vector must end on the arc of a circle.

That the construction given represents these facts is shown from the consideration that on throwing full line voltage on the unexcited machine we should have a total current (in Fig. 2) equal to *CP*, the vertical component of which represents the true power absorbed. The circular current locus has in this case shrunk to the point *C*.

It is obvious that a synchronous motor cannot operate at zero power-factor on account of the losses of the machine;

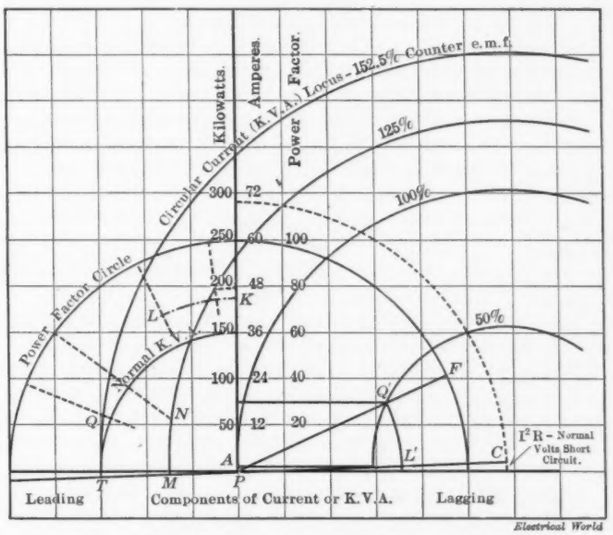


Fig. 2—Synchronous-Motor Performance Diagram.

hence the *CP* line represents the "synchronous condenser" operating power-factor, so far as armature copper losses are concerned.

If the load of a given excitation changes, the current line moves so that its vertical component represents the power absorbed. This entails a change in power-factor and shows at a glance why the power-factor of an over-excited motor increases first to 100 per cent and then becomes lagging with further increase of load.

It should be noted that the circular current loci are reckoned on the basis of motor counter emfs expressed in percentages of the generator or line voltage, assumed constant; also that it has been assumed that the impedance of the circuit remains constant. This latter assumption is, of course, not in accord with the facts, and in order to take account of this it may be recalled that the initial part of the no-load saturation curve is, for a considerable distance, practically a straight line. Let this be continued indefinitely. Read vertically upward to meet it, from the normal voltage point, on the actual saturation curve, and thence horizontally to the voltage axis to find a new value, which is taken as the fictitious 100 per cent voltage. Then, when it is desired to find the actual field amperes corresponding to a given percentage excitation in Fig. 2, proceed horizontally from the voltage axis of Fig. 1 (starting from the given percentage reckoned in terms of the fictitious 100 per cent value), out to the no-load saturation curve and thence downward to the required field amperes. This method has been compared with the actual test values on many machines for various armature currents at different power-factors, and the results appear never to be in error by more than 5 per cent. These may reasonably be construed as graphical errors, though the calculated field amperes appear to have lesser values within the range stated than the field amperes developed on test.

While it is not contended that this method gives rigorously exact results, it is believed that it will show at least as great accuracy as other graphical methods, will have the added advantages of simple and easy construction from two or three ordinary tests, and will harmonize with the A. I. E. E. Standardization Rules, paragraph 207 (1910), for regulation computation.

A few applications of the method will be cited to show its operation. Given a 150-kva, 2400-volt, three-phase motor, for which typical saturation curves are given in Fig. 1, the current is then 36.1 amp per phase at full load.

The short-circuit curve of Fig. 1 shows that with full voltage thrown on the machine, unexcited, there would be produced a current of 70 amp, and the corresponding "short-circuit losses" curve (if taken) gives 10.25 kw, which may be taken, without material error, as the I^2R losses; otherwise they may be worked out from the average resistance between terminals, of 1.018 ohm, making an allowance for the increase of resistance with temperature of the standard 0.4 per cent per deg. C., appreciating that with a normal 35 deg. rise machine so large a current would give a rise of, say, 70 deg. C. As will be seen, the exact figure will not be important, as the discrepancy will not be appreciable on the scale to which the rest of the figure is drawn. Strictly speaking, the energy loss will involve the eddy current heating, which may be accounted for by correcting the resistance taken by direct current to the amount obtained with alternating current of the frequency of the circuit. For most commercial 60-cycle machines a value of 1.15 will be sufficiently accurate for the ratio of the latter to the former resistance for calculations like the present.

Fig. 2 being constructed as previously indicated, it will be seen how small is (generally) the distance of the point *C* above the base line, so that, unless heavy loads or questions of pull-out torque and hunting are under consideration, the error introduced by assuming the machine resistanceless will be small. The 100 per cent counter-emf excitation is represented by *PC*, with other distances along that line proportionally, from which point are drawn the various circular current loci indicated.

With Fig. 2 drawn as indicated above, the following problems are considered as of practical interest to an operator:

1. With the machine excited for full-load kilovolt-ampere at zero power-factor, what will be the armature kilovolt-ampere and power-factor when carrying a load (including its own losses) of 60 kw? From the full-load point (150) on the kilowatt axis swing an arc to the base line at *T*, and with *CT* as radius describe the circular current locus which corresponds (as worked out) to 152.5 per cent counter-emf excitation. From the 60 point on the kilowatt axis draw a horizontal line to meet this circular current locus, and draw through the intersection *Q*, from the origin, a radius to the power-factor circle; projecting the end of this radius on the power-factor axis at 38. The current (or kva) *QP* is swung around to the vertical axis and read as 159 kva, which at 38 per cent power-factor means 60.4 kw, or an error of 0.6 per cent.

2. Find the excitation required for 125 per cent of normal kva at 90 per cent "leading" power-factor. From *K* ($= 150 \times 1.25$) on the kilowatt axis strike an arc to *L* on the 90 per cent "leading" power-factor radius; *CL* is the corresponding percentage counter-emf and equals 138.5, which corresponds (from Fig. 1) to 21.7 amp, reckoned as indicated above.

3. For a given field excitation of, say, 19.2 amp, equivalent to 125 per cent counter-emf, and an operating power-factor (= 60 per cent "leading"), find the armature kva and kw. From N, the intersection of the appropriate circular current locus with the 60 per cent "leading" power-factor radius, draw a horizontal to the load axis at 53 kw. Then $53 \div 0.60 = 88.3$ kva, which checks as closely as can be read with the value found by swinging an arc from the intersection just mentioned to the load axis (using P as a center).

4. With an excitation of, say, 19.2 amp, corresponding to 125 per cent counter-emf, and a load of 200 kva, find the operating power-factor and kw. Through the intersection of the 125 per cent counter-emf circular current locus with an arc from the 200 point (P as center), draw a radius from P to the power-factor circle, and read the power-factor as 99 per cent "leading," which gives 198 kw.

5. With kva and kw given, the power-factor is known at once numerically, but there are two solutions for the excitation, one with "lagging" and one with "leading" power-factor, and equal, respectively, to the distances from C to the intersections of the horizontal through the given kw, with the radii at the indicated power-factor; for example, with 200 kva and 182 kw, which means 91 per cent power-factor, the excitations are approximately 11 amp and 24.3 amp respectively.

These examples will suffice for illustration of the simplicity and rapidity of the process; in fact, much of the computation can be picked out at once by the eye.

The example in case 5 brings out the point of two excitations existing for a given load as ordinarily shown in the familiar "V" curves, and with such directness as to make the plotting of these curves unnecessary.

The "O" curves of mechanical outputs for a given excitation may be calculated, though not directly deducible, but they have little practical value, for two reasons: first, the limiting condition of operation is armature current, assuming the field able to carry all the current that the exciter can force through it, and this armature current can be found at once; and second, the "O" curves are not complete in themselves, making no separation of friction, windage and core losses.

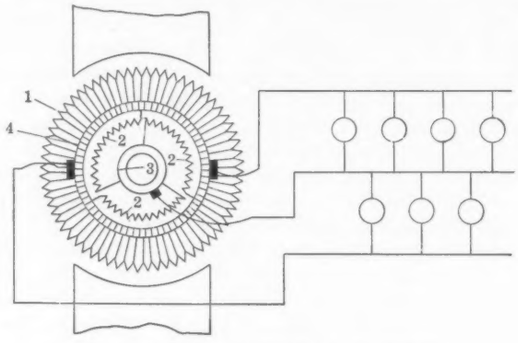
All the foregoing has been based on the constancy of the applied voltage. Should this change, it is only necessary to treat Fig. 2 as though the motor in Fig. 1 had been wound for the voltage actually applied, with due consideration of the proper change in normal kva rating on the basis of proper change in iron-loss and so many armature amperes producing the heating of the full-load guarantee, and then revising the figure accordingly.

It is hoped that the simplicity and accuracy of the above method will appeal to the man who must make many calculations as well as to the practical operator desiring a little more insight into the operations of his machine.

MODERN THREE-WIRE DIRECT-CURRENT GENERATORS.

By C. L. Pilger, Jr.

In a recent article published in the *Electrical World*, entitled "Three-Wire Direct-Current Generators," by Mr. W. G. Merowitz, the author described the earlier forms of three-wire generators or systems, that is, two generators connected in series with neutral lead brought out, the single generator with balancer set in shunt, and finally the single generator with attached or separate balance coils, which is generally known as the Dobrowolsky system. There is, however, another form of three-wire generator now on the market which deserves attention on account of its excellent characteristics as regards efficiency, stability of voltage and simplicity. This machine is similar to the ordinary two-wire generator, except that it has an auxiliary winding so distributed over the face of the armature that the average field in which it moves is always uniform. Any tendency toward flickering is therefore reduced to a minimum. Furthermore, the auxiliary winding forms a circuit in parallel with part of the main winding and generates useful energy all the time, even when the load is balanced.



Double-Winding Three-Wire Generator.

Hence the overload capacity of such a machine is considerably increased. When balance coils are used there is considerable loss while the machine is in operation, whether the load is balanced or not.

When it is considered that the machine with the auxiliary winding has only one collector ring and no additional apparatus of any kind, its simplicity and efficiency as compared with other systems will readily be understood. The relative arrangement of the armature and auxiliary winding is shown in the accompanying diagram, where 1 is the main winding, 2 the auxiliary winding, 3 the ship-ring and 4 the commutator. For the sake of simplicity only three windings are shown, but in practice there are usually more.

The voltage of the neutral wire is always the sum of the voltages generated in the coils that are in series between the collector ring and one of the brushes, and this voltage is just one-half the voltage generated by the main winding.

RECONSTRUCTION OF COLORADO STATION.

The Trinidad Electric Transmission, Railway & Gas Company recently completed the rehabilitation of its Trinidad steam-power plant, destroyed by fire two years ago. The station was placed temporarily in operation immediately after the fire, but an entirely new building has now been constructed and the equipment augmented and rearranged. The building is of pilastered brick construction, with metal roof on steel trusses, and with brick division walls separating the plant into a boiler-room section of 9500 sq. ft. area, an engine-room of 2500 sq. ft., a transformer and switchroom of 4000 sq. ft., and a boiler auxiliary room of 4500 sq. ft. All these sections communicate through ordinary doors. The transformer section has a concrete barrier wall to prevent escaping oil from entering other parts of the building. All floors are of concrete.

The equipment consists of 2500-kva, 1000-kva and 500-kva Westinghouse turbo-generators with La Blanc condensers and the usual auxiliaries. The boiler-room contains four 600-hp Parker water-tube boilers, four 250-hp Franklin and four 300-hp Altman-Taylor water-tube boilers. The Parker boilers are equipped with Green stokers. Coal elevator, hopper feeds and ash conveyor are all operated by induction motor. The exhaust fan is driven by motor or by a small Sturtevant engine. The station supplies energy for street and building lighting in Trinidad, for the interurban railway, to surrounding coal-mining districts, and to electric hoists, crushers, screens, fans, pumps, etc., in the surrounding coal mines.

Central Station
Management, Policies and Commercial Methods

PUBLIC-UTILITY MEN AS CITIZENS.

According to Mr. W. H. Hodge, who is manager of the publicity department of H. M. Byllesby & Company, new and higher standards are in process of formation in all lines of commercial endeavor. Merely being honest is insufficient; merely being lawful does not place an individual or corporation beyond proper criticism. Mr. Hodge prepared a paper on the subject for the recent convention of the North Dakota Electrical Association. The observations given here are the substance of some of the conclusions set forth in that well considered essay.

The author remarked that eventually the only utilities remaining indifferent to the needs and welfare of the public will be municipally owned and operated plants. Even these in time will be forced to consider the rights and convenience of their customers. A few city-owned plants already have taken the modern view of their obligations and are striving to place their methods on a par with ordinary commercial undertakings.

Central-station men should be fully alive to the trend of the times. They have done much for the development of their country; now they should be no less active in advancing its sociological welfare. Utilities are often under the stress of political attack, selfish agitation, ignorance and prejudice; nevertheless there is neither necessity nor excuse for departure from good morals in the conduct of such enterprises. In the long run anything short of this does not pay. The author quoted Mr. H. M. Byllesby as saying, "The smartest thing that any man can do is to be absolutely and continuously honest."

Mr. Hodge said that every employee of a utility company should display an active interest in community affairs; he should be a "booster" for his town. Moreover, he should believe in the economic soundness of his occupation. He should be a student and should inform himself of the fundamental reasons that justify the existence of the industry by which he makes his living. Further, he should strive at all times to cheapen the cost of service and to extend the service to the greatest number of people.

Central-station companies emphasize their good citizenship in many ways. They watch over the health and prosperity of their employees; some of them offer free fan service to invalids unable to pay; some maintain industrial promotion departments to bring industries to the town; others make beauty spots and erect handsome buildings provided with conveniences for the comfort of the public; still others have helped out city treasuries by pre-payment of compensation or have assisted in placing municipal bond issues. Quite generally utility companies are leaders in all public subscription lists for sound purposes, while the amount contributed to charities is larger than is realized by the general public. All this is not philanthropy; it is good citizenship. Besidès, a company can sell more service to a friendly public than to an unfriendly public.

The author expressed his belief in newspaper advertising for utility companies. "Say what you have to say freely and frankly over the company's name. Be outspoken and courageous. Secret methods are thought to relate to wrongdoing which cannot bear scrutiny." At the close of his paper Mr. Hodge gave another example of central-station good citizenship by showing how rates for electrical energy have been widely and substantially decreased in recent years, while the price of nearly all other commodities has been increased. Public utilities, he said, in effect, have "made good"; but they must still have faith in the public, still be active and zealous in making the hard climb that continually stretches ahead as the pathway of mankind.

A DULL-SEASON HOUSE-WIRING CAMPAIGN.

During a recent "dull" period when electrical construction was slack and local contractors were deploring the lack of work, the Great Falls (Mont.) Electrical Properties inaugurated a house-wiring campaign directed particularly at a class of small, unpretentious residences which it had hitherto not succeeded in connecting to its lines. A schedule based on $1.65 per outlet was offered such prospective customers, this rate representing a cut below the actual cost of having local contractors do the work. To the first twenty-five new customers making payment in full the company also offered to present 6-lb. electric flatirons.

As the result of seventy-five days' advertising and campaigning with the help of newspapers, solicitors, contractors, etc., besides letters sent to every unwired house, a total of 150 new residence customers were secured. The average cost of the construction done in these houses ranged from $10 to $15, and to the amount the customer paid the central station added enough to secure the contractors an average profit of 20 per cent. Customers unable to pay cash were granted thirty to sixty days' credit, the company advancing cash to the contractor as the work was done. Practically every new consumer secured in this campaign was in fact presented with a flatiron costing $3, the limitation of the first twenty-five, as originally stated, being purposely waived. The presence of these irons on the lines, it was realized, not only insures good revenues from off-peak demands, but helps prevent customers from wanting their service disconnected during the summer months, when the long twilight which Great Falls enjoys makes the demand for artificial lighting small. The 150 additional residences secured in this campaign cost the company about $5 each, according to Mr. E. I. Holland, local manager. This figure includes, of course, the $3 irons presented to the majority of the new users. The campaign occupied the attention of the central-station forces at a time when its regular duties were not pressing, a good block of desirable business was secured, and both local contractors were enabled to keep a couple of wiremen busy during a period otherwise expensive to weather, so the campaign is, as a whole, regarded as highly successful.

ELECTRICITY IN GOLD REFINERIES.

The United States Reduction Corporation, a subsidiary company of the United States Gold Corporation, has recently completed a gold-refining plant at Sugar Loaf, Boulder County, Col., in which plant electrical energy will be used for all available purposes. The method practiced at other plants owned by this company of electrolytic precipitation of gold from leeching tank solution has been adopted also for this plant. After having been passed through electric driers the gold precipitate is smelted and purified in a 15-kw electric arc furnace, the latter being controlled by an automatic circuit-breaker. Induction motors are used for restoring the cyanic acid solutions to the storage tanks and for maintaining pressure on the water mains for fire protection. The 500-ton crusher rolls, elevators, main drier, screens and trommel are operated by a 100-hp induction motor. A 20-hp motor-generator set furnishes direct current at 10 volts for electrolytic purposes. The Central Colorado Power Company furnishes the energy at 11,000 volts, the emf being reduced to 440 volts for motors and 110 volts for lighting purposes.

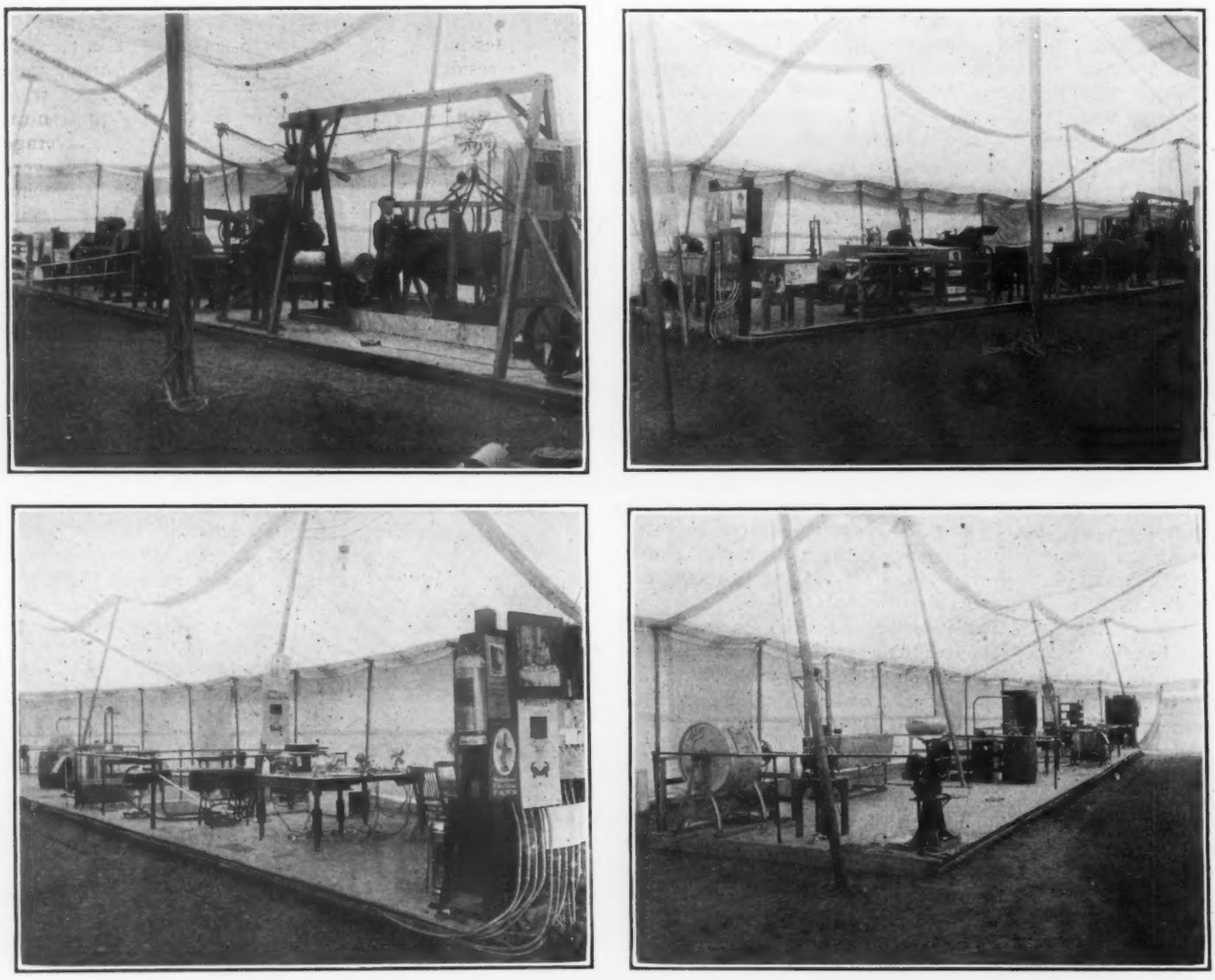
A similar plant, also on the Central Colorado Power Company's system, is that of the Gold Bullion Milling Company near Rowena, Col. In this mill a 50-hp induction motor operates on a common shaft a 75-ton crusher, fine and coarse rolls and two trommels. A 15-hp motor drives through a single shaft nine Monnell shaking tables and a 10-hp motor drives six Monnell slimers. A 15-hp motor is directly connected to a turbine pump in the creek bed, which delivers 350 gal. per minute of water under 100-ft. head to tables and slime tanks. A substation erected 50 ft. from the mill contains three 30-kw transformers for reducing the emf from 11,000 to 110 volts.

ELECTRIC FARM EXHIBIT.

The Edison Electric Illuminating Company of Boston, Mass., recently completed an electric farm exhibit which is attracting wide attention throughout eastern Massachusetts. The display was prepared by the company to acquaint the public more fully with the numerous applications of electricity which are now practical in agricultural work. The company's suburban lines traverse a large semi-rural area in which market gardening and small-scale farming are prominent occupations, and for some time it has been apparent that a demonstration of electrically operated farming appliances in the concrete would do much to stimulate this class of business.

The exhibit is housed in a 103-ft. x 50-ft. tent located on the old Middlesex Fair Grounds in South Framingham and is divided into sections illustrating the uses of electricity in the barn and workshop, living room, kitchen and dairy. The tent is of oval shape, 24 ft. high in the center, with 10-ft. side and 18-ft. intermediate poles. No admission is charged and large signs welcoming passers-by to look into farming by the electrical method are installed on the front of the grounds facing the local street railway line. Energy for the operation of the exhibits is supplied from the company's overhead system, which at this point is about 25 miles from the main generating plant in South Boston.

The displays are arranged along the sides of the tent, leaving a central aisle free for the movements of visitors. The tent is illuminated by thirteen 500-watt tungsten lamps equipped with prismatic shades and hung from ropes. All lighting and motor circuits are metered and fused on a distributing board mounted on a frame just inside the main entrance. The exhibits are installed upon low platforms and are continuous, all equipment being wired to the distributing board by underground connections. The barn and workshop section includes a variety of motor-driven apparatus, covering breast drills, buffing and grinding outfits, branding iron, forge blower, glue pot, soldering irons, pump jack, meat chopper, grindstones, circular saw, vegetable cutter, corn sheller and bone grinder, besides an electrically heated incubator, wood saws and choppers, horse groomer and clipper, feed cutter and portable truck. Two horse and two cow stalls are provided, and an electrically driven milking outfit is in regular service. A large motor-driven hay hoist demonstrates the facility with which the livestock



Views at the Electric Farm Exhibit, South Framingham, Mass.

may be supplied or fodder transported on the premises.

The living-room section, 17 ft. by 12 ft., contains various domestic appliances, including electrically heated flatirons, percolators, toasters, chafing-dish and furnace-blower equipment, sewing machine and vacuum-cleaning outfits. The kitchen contains an electric cabinet, fireless cooker, range operated by resistance grids, motor-driven potato peeler, clothes washer, ice-cream freezer, pump and waffle-iron grid. A refrigerator, cream separator, cream tester, butter churn and bottle washer are arranged for demonstration in the dairy section. A 30-kw transformer supplies the whole installation, the distribution being at 110 and 220 volts. Emphasis is laid by the company upon the point that the devices shown are worth while for the small farm no less than for larger acreages. The display is open daily from 10 a. m. to 10 p. m. and is designed to facilitate ready dismantling, transportation by electric trucks and erection from time to time in other parts of the company's 600-sq. mile territory.

Wiring and Illumination

HOUSTON'S DOWNTOWN MAGNETITE ARC LIGHTING.

The Houston (Tex.) Lighting & Power Company has just completed the installation of eighty handsome iron poles carrying 4-amp magnetite arc lamps which furnish illumination for the business district of the city. These poles are of an attractive design, originated locally and

Original Design of New Magnetite-Arc Poles at Houston, Texas.

built by the St. Louis Car Wheel Company to conform in base pattern with the new trolley poles on the business streets, in some cases combination poles being used for both railway and lighting purposes. The standard arc-lamp poles are respectively 6 in., 5 in. and 4 in. in diameter, tapering in three sections as the illustration shows. The combination trolley and arc-lamp poles are 8 in., 7 in. and 6 in. in section and weigh 800 lb. each. Three-inch pipe forms the gooseneck, the lamp itself being suspended with the arc 19 ft. above the roadway. There are four lamps to each 330-ft. block in the downtown section, the posts being staggered so that each corner is lighted by two lamps while the greatest mid-block distance between lamps is about 110 ft. Lead-covered, paper-insulated No. 6 single-conductor cable is used to lead the current to the lamps. Although this cable is 7/8 in. in outside diameter, the pipe spaces afford ample clearance for bringing in the pair. The lamps are stationary in position, being trimmed with the aid of a ladder wagon. Alba globes are used to diffuse the direct rays of the 4-amp magnetite arcs, but these are to be replaced in some cases with clear glass to increase the light from the lamps.

A PHOTOGRAPHIC METHOD FOR RECORDING CANDLE-POWER DISTRIBUTION CURVES.

By Herbert E. Ives and M. Luckiesh.

The photometry of arc lamps is peculiarly difficult because of the fluctuating character of their light. The use of an integrating sphere probably presents the most practical solution of the measurement of mean spherical candle-power of such sources, for thereby the only fluctuations to consider are those of total light. An average value may be obtained from a series of measurements not of prohibitive length. But when the object is to determine the distribution of candle-power about the source the measurements are complicated not only by the fluctuations of total light but by fluctuating distribution. In order to obtain such measurements it is necessary to make literally thousands of settings of the fluctuating source in terms of the steady working standard. The time necessary for these settings and the time lost in waiting for the arc to become reasonably steady mount up to a costly total, and at their best such measurements cannot lay claim to any great accuracy. The usual practice of employing a working standard of very different color from the light under measurement is also a source of inaccuracy, usually considered as trivial, however, as compared with the huge uncertainties caused by the unsteadiness of the light.

In this paper is described a photographic method for obtaining candle-power distribution curves, peculiarly applicable to arc lamps and other fluctuating sources. The reasons for trying the photographic plate are, first, its property of recording simultaneously phenomena extended in space; second, its property of integrating the action of light over an extended period. The proper utilization of these two properties should make it possible to overcome the difficulties introduced by the various fluctuations of the arc lamp.

In order to use photography a knowledge of the behavior of the sensitive plate is essential. A study of the application of the photographic plate to photometric problems has been published elsewhere by one of the present writers,[1] and reference should be made to it by those interested in applying the results of this paper. It is sufficient to say that a close correspondence exists between the intensities of incident light and the resultant densities of the plate over a range of intensities of from 30-to-1 for a fast plate to as much as 100-to-1 for a slow plate, in the region of "normal exposure." If upon a normally exposed and developed plate one has in addition to the pictures of the test surfaces pictures of a set of comparison patches of known relative brightness, it is possible by measurement of densities to find the relative brightness values of the different points on the test surface. Obviously, since the plate must be measured point by point on a photometer there will be no

[1] "The Application of Photography to Photometric Problems," by Herbert E. Ives. *Trans.* Ill. Eng. Soc., March, 1912.

great advantage in using photography for obtaining the distribution curve of a steady source, because the number of photometric operations is as great as by the ordinary method and in addition there are the photographic ones. For fluctuating sources, however, the case is different. A single set of photometric measurements and a single set of photo-

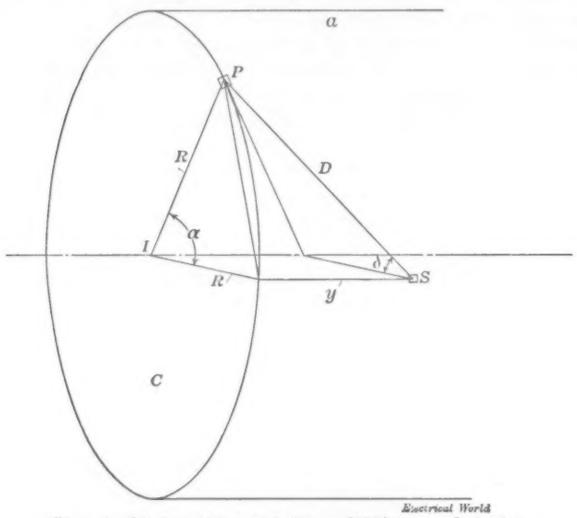


Fig. 1—Photometric Relations Within a Cylinder.

graphic operations take the place of the hundreds or more of photometric settings usually made.

The essential parts of an apparatus for photographic determination of distribution curves are two—first, a surface surrounding the source in such a manner as to receive illumination from it, bearing a known relation to the intensity in the various directions; second, a set of illuminated patches of known brightness, of a range to include all those desired range of brightness may be obtained. These must be measured with an illuminometer, and by preference the measurement should be made from the point where the camera lens is to stand. This can usually be accomplished by placing over the illuminometer tube a lens of such focal length as to form an image of the object in the plane of the photometer screen. In the procedure as here described it is necessary to know only the relative brightness of the different patches. The absolute brightness may be varied by the size or operating voltage of the incandescent lamp to suit the brightness of the surface illuminated by the test lamp.

For a surface to be illuminated by the lamp under test several possibilities were considered—a small surface on a radial arm, which might be rapidly rotated; a set of small surfaces shielded from each other's light by radial screens,

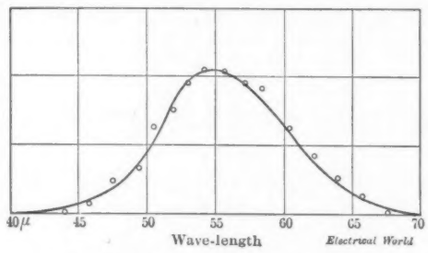


Fig. 3—Spectral Distribution of Light.

or a cylindrical surface with its center at the light source. A slight modification of the latter idea was decided upon. It is clear that the brightness of a ring or section of a uniformly diffusely reflecting cylinder will indicate the distribution of candle-power of a source of light at its center in the common plane of the source and ring, provided the illumination of any point in the ring is due solely to the light source at its center. That this condition may be

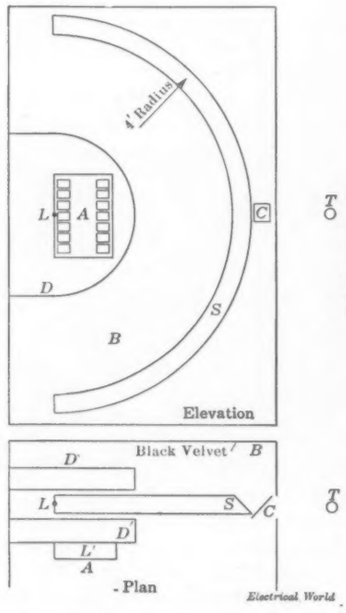
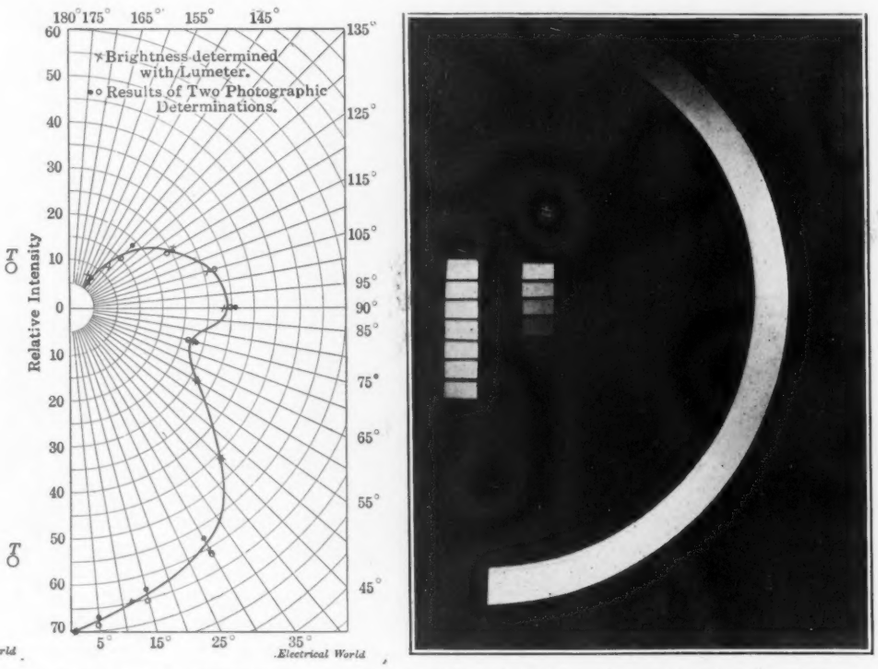


Fig. 2—Arrangement of Apparatus.



Figs. 4 and 5—Distribution Curve of Reflector and Photographic Determination of Same.

on the illuminated test surface. The latter part of the apparatus may be very simply constructed by placing an incandescent lamp behind a sheet of opal glass (this glass forming one side of the box inclosing the lamp). Either by having the lamp placed very close to one end of the glass or by a series of absorption glasses, or both, any very closely approached is shown by the following analysis:

Let *C*, Fig. 1, be a tube of circular cross-section, of radius *R* and length *a*. Let the tube be of diffusely reflecting material, obeying Lambert's law. In its axis let there be a point source of light of intensity, I_a in any direction α (measured from some arbitrary zero angle). Assume that

the radius R is so large in proportion to the length of cylinder to be used that the illumination is uniform along any element of the tube, and equal to $\frac{I_a}{R^2}$. Let the reflecting power of the surface be such that the brightness per unit area under unit illumination is ρ. The intrinsic brightness of the surface at any point due to the central light source will then be $\frac{I_a \rho}{R^2}$. The brightness of the cylindrical tube due to the light source alone is a measure of the candle-power in various directions. But in addition to the direct light of the source each element of the tube receives reflected light from the other illuminated elements. The distribution as obtained from the intrinsic brightness is in error by the amount of the reflected light. The amount of this error can be calculated as follows:

Let P be the point whose brightness is to be measured. Its brightness due to the source is $\frac{I_a \rho}{R^2}$. Take any element on the cylindrical surface, as S. Let the linear element of the cylinder of which it is a part be at the angle α from the element containing P, and let its distance from the vertical plane through I and the cylinder be y.

The illumination at P due to the element $R dy d\alpha$ at S is

$$R \frac{I_a \rho}{R^2} \frac{\cos \delta \, dy d\alpha}{D^2}$$

and the brightness at P due to the element at S

$$b_p = R \frac{I_a \rho^2}{R^2} \frac{\cos^2 \delta \, dy d\alpha}{D^2}$$

$$\text{Now } \cos \delta = \frac{2R \sin^2 \frac{\alpha}{2}}{\sqrt{4R^2 \sin^2 \frac{\alpha}{2} + y^2}}$$

and $D^2 = 4R^2 \sin^2 \frac{\alpha}{2} + y^2$

Substituting

$$b_p = R \frac{I_a \rho^2}{R^2} \frac{4R^2 \sin^4 \frac{\alpha}{2}}{(4R^2 \sin^2 \frac{\alpha}{2} + y^2)^2} dy d\alpha$$

and for the total brightness at P

$$B_p = \frac{\rho}{R^2} \left[I_o + \frac{\rho}{4R} \int_{-\frac{a}{2}}^{+\frac{a}{2}} \int_o^{2\pi} \frac{I_a \, 16 R^4 \sin^4 \frac{\alpha}{2} \, d\alpha \, dy}{(4R^2 \sin^2 \frac{\alpha}{2} + y^2)^2} \right]$$

In order that this shall differ as little as possible from $\frac{I_o \rho}{R^2}$ the second term must be small. This may be attained by making R large (in proportion to a) and by choosing a material for which ρ is small.

In order to learn the values of a, R and ρ which are necessary to render the scheme practicable we may proceed as follows:

Let the intensity of the source be a minimum at the angle O, and let I_m be its maximum intensity, then the second term will be less than

$$\frac{I_m \rho}{4R} \int_{-\frac{a}{2}}^{+\frac{a}{2}} \int_o^{2\pi} \frac{16 R^4 \sin^4 \frac{\alpha}{2} d\alpha dy}{(4R^2 \sin^2 \frac{\alpha}{2} + y^2)^2}$$

Performing the integration, we obtain for the brightness at P

$$B_p = \frac{\rho}{R^2} \left[I_o + I_m \frac{\pi a \rho}{2R} \right]$$

The required condition is that $\frac{\pi a \rho I_m}{2R}$ be less than the permissible error in measuring I_o. As a practical case take $\frac{a}{R} = \frac{1}{10}$ and consider a perfectly reflecting matte surface. For the latter $\rho = \frac{1}{\pi}$; then the error becomes 0.05 I_m.

If a common "black" paper is used ρ drops to about 1/25 $\times$ 1/π and the error becomes 0.002 I_m. Expressed as percentage of I_o this amounts to 5 per cent in the case where $\frac{I_m}{I_o} = 25$. Usually, however, on a distribution curve it is fair to base the discussion of accuracy on the maximum intensity. At any rate, it is evident that the errors may be made quite small by proper choice of $\frac{a}{R}$ and of ρ.

The test surface here used was a modification of the cylindrical surface just considered and consisted of a 180 deg. section of a 45 deg. cone. Its radius in the plane of the light source was 4 ft., its height 5 in. It was formed by mounting heavy cardboard on a specially constructed wooden frame. Measurement of the brightness of a shadow cast by a narrow rod at the brightest portion of the illuminated surfaces showed it to be on white blotting paper less than 2 per cent of the brightness alongside. A dark matte gray surface was used in the work, made by painting the cardboard with a mixture of zinc oxide and lampblack in alcohol, and the brightness of a shadow on it fell below 1 per cent of the unshaded portion, appearing in fact as black as the background of unilluminated black velvet.

The complete apparatus is shown diagrammatically in Fig. 2. S is the test surface, L the light source (which should be arranged to rotate), B the background, consisting of a black cavity lined with black velvet. D, D' are screens which prevent the light from the source striking the velvet background. A is the box of comparison patches, illuminated by an incandescent lamp L'. C is a small auxiliary surface, illuminated by a standard lamp T, to be used where absolute candle-power values are desired.

The photographic camera was placed about 15 ft. from L. With the lens used, the image practically filled the half of a 10-in. by 12-in. plate. In order to obtain an identity of the visual and photographic values a "visual luminosity" filter was used. This color screen, consisting of a mixture of certain dyes in gelatine,[2] when used with Cramer's spectrum plates gives a curve of action through the spectrum closely that of the eye, as shown in Fig. 3. This screen was used because it was at hand. Probably certain visual luminosity filters on the market, if used with their appropriate plates, would have served sufficiently well.

The proper development of these plates, using metol-hydrochinone, was determined by plotting photographic densities against the logarithm of intensities. A development of three minutes at room temperatures was found to be sufficient to give a development factor of unity; that is, a given percentage variation in illumination is represented by the same percentage variation in transmission of the negative. By similar plots the proper exposure for different brightnesses of the collection of comparison patches was determined, in order that these should be evenly distributed about the region of "normal" exposure.

The typical procedure is as follows: The lamp whose candle-power distribution is desired is put in place; the lamp behind the comparison patches is adjusted in voltage until the brightest patch is somewhat brighter than the brightest part of the illuminated test surface. When this condition is attained it also means that the darkest patch is practically darker than the darkest part of the test surface, for in the

[2] "Distribution of Luminosity in Nature," by Ives and Luckiesh. *Trans.* I. E. S., Vol. VI, page 67.

former, as constructed, a range of 300 to 1 obtains. With the previously obtained correct exposure for the comparison patches the complete set-up is photographed and the plate developed and tested for density on a Martens polarization photometer. Corresponding densities on the test-surface picture and on the comparison patches correspond to the same relative brightness; hence a set of points is obtained giving the distribution of intensity around the source of light.

Some experiments were made to test the performance of various parts of the apparatus and various stages of the process. An exceedingly long exposure was made to determine whether the background might be considered truly "black." Although the plate was excessively overexposed on the illuminated parts no action was obtained from the background. An illuminated piece of black cardboard at the same time gave a strongly developed image. Next a test was made to determine how accurately the process of photography and measurement reproduce what is before the camera. The test surface, illuminated by an incandescent lamp in a reflector, was measured for brightness from the position of the camera lens, by means of an illuminometer behind a telescope which formed a focused image of the test surface on the photometer screen. The points thus obtained are shown in Fig. 4, together with the results of two photographic determinations. The agreement is quite satisfactory. Fig. 5 is a reproduction of a print from one of the photographic negatives.

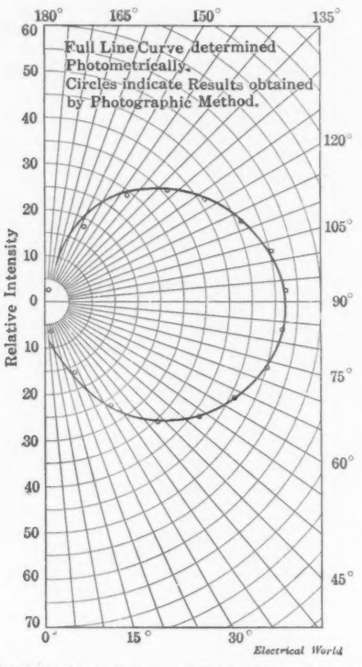

180° 165° 150° 135°
Full Line Curve determined Photometrically.
Circles indicate Results obtained by Photographic Method.
Relative Intensity
60 50 40 30 20 10 0 10 20 30 40 50 60 70
120° 105° 90° 75° 60° 45°
0° 15° 30°
Electrical World

Fig. 6—Distribution Curve of Bare Incandescent Lamp.

There remains after this test the question of how accurately the illumination on the test surface corresponds to the candle-power distribution as determined by other means. This depends on the perfection of the test surface—its trueness of angle, its diffusing power, etc. In the test surface constructed the cardboard was carefully set at 45 deg. all along its length by wedges. The coating of lampblack and zinc oxide showed less specular reflection than anything else tested by us. There was, however, some tendency of the cardboard to warp, and the zinc oxide-lampblack paint was not absolutely uniform, as some streakiness showed.

In Fig. 6 is shown the candle-power distribution curve of a bare lamp, measured photometrically, at a distance of 4 ft., by an independent laboratory. The circles represent the points determined photographically. There is excellent agreement except for the lowest illuminations. The deviation of these points may be due to errors in the photometric work, to inaccuracies in the determination of the brightness of the low-intensity comparison patches, or again to the fact that the photographic plates used were not of plate glass and therefore likely to be concave and of irregular thickness of coating. On the whole, however the agreement is good, and by the use of plate-glass sensitive plates and by calibration of the reflecting power of the test surface point by point the outstanding differences would probably entirely disappear.

These experiments were made with non-fluctuating sources, for which a photographic method offers no special advantages, but the results apply equally well to fluctuating sources, once the apparatus and photographic procedure are in shape to photometer a non-fluctuating source correctly.

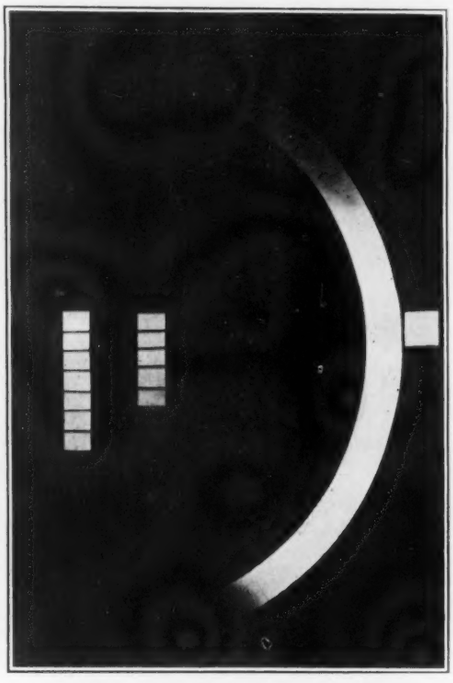


Fig. 7—Scheme for Testing Arc Lamps.

If the law connecting time of exposure with intensity of incident light were that these two factors, time and intensity, are equivalent, then the photographic method would be applicable not only to obtaining distribution curves but to obtaining actual candle-power value. The law which actually holds is that for equal densities on a plate

$$It^p = iT^p$$

where I and i are the larger and small intensities, T and t the larger and smaller exposure times and p is a constant of value usually between 0.8 and 1.0. In other words, a more intense illumination is more effective than a correspondingly increased time of exposure with a low intensity. Applying this law to the case of two illuminations, one constant, the other twice as intense but acting only half the time, it appears that the latter will produce a photographic action greater than the former. For a value of p of 0.85 this excess will correspond to about 7 per cent. It is therefore to be expected that the photograph of the fluctuating light from an arc lamp will indicate a candle-power somewhat above its true mean value.

This point was tested for the Cramer spectrum plate for which $p = 0.85$. A fluctuating illumination was produced by a slowly rotating sector over an opal glass opening. The illumination passed through three stages—high, medium and low—of 23, 19 and 10 units. Its mean value was calculated and an exposure made to that illumination between two exposures on the fluctuating one. The fluctuating illumina-

tion gave a slightly greater density corresponding to about 4 per cent greater steady illumination. As this error is always in the same direction and probably will average very nearly a constant—namely, 5 per cent—it might be quite satisfactory to use the photographic method and make a correction of this amount. The result would, in the case of an arc lamp, probably be as close as can be obtained by any present method.

Fig. 7 shows the complete scheme for test of an arc lamp. The auxiliary side patch is illuminated by a standard lamp; the arc is supposed to be rotated in order to secure the mean value of all directions. Values of both the auxiliary and the test surfaces are obtained in terms of the comparison patches and in terms of each other. With a 6-amp arc, at a distance of 4 ft. from the test surface, an exposure of fifteen minutes is sufficient with the camera, plates, etc., used. A test surface at a greater distance will require increased exposure, but by using a larger aperture lens, quicker light filter, etc., the exposure may be held to about this length if desired.

The result of this investigation is to show the entire feasibility of the photographic method of obtaining candle-power distribution curves in the case of fluctuating sources, which are now measured visually. While the method is subject to a limitation when used to obtain the total candle-power of a fluctuating source, the error is small and may be allowed for with a final result probably as accurate as is given by present methods.

Certain refinements and variations in the entirely experimental procedure here described may be expected to provide increased accuracy. These are the use of photographic plates made of plate glass and the calibration of the illuminated test surface for reflecting power point by point. It is possible also that a cylindrical instead of a conical test surface might be more accurately made and be less liable to give an admixture of specular reflection. These are, however, points to be settled by further trial on a larger and more technical scale.

Letters to the Editors

THE CANDLE-PER-WATT METER.

To the Editors of Electrical World:

SIRS:—In connection with the proposal of Dr. Herbert E. Ives in your issue of June 8 for a new form of bolometric candles-per-watt meter for rating incandescent lamps, the following brief account of the development of such an instrument may be of interest to your readers. The work in question was carried on by the writer in the laboratory of the Westinghouse Lamp Company early in the month of April, 1911.

As a preliminary determination of the possible accuracy of the instrument, a screen was made by winding 63.4 ohms of bare No. 40 B. & S. gage copper wire on a light frame of glass rod. It was found that the resistance of this screen increased 0.395 per cent when placed within 4 in. of a 25-watt tungsten lamp operating at 1.25 watts per candle. A change of 1 per cent in the specific consumption of the lamp, produced by changing the applied voltage, caused a corresponding change in the resistance of the screen of the order of 0.00016 per cent. The "time-lag" between the lamp and the screen was of the order of fifteen seconds.

Further experiment showed that the effect on the screen was attributable entirely to the radiant energy absorbed by it and was independent of local air currents set up by the hot lamp. A brief investigation of the available screens for dividing the radiation into two parts, the ratio of which would be the basis for determining the specific consumption of the lamp, soon showed that this part of the scheme, as Dr. Ives has outlined it, was impracticable for the desired purposes.

The difficulty was avoided by dividing the screen into two portions by making connection with its middle point and by covering one-half with a thin layer of bluish sulphide, which was accomplished by exposing it to sulphuretted hydrogen. There was thus obtained a screen which could be substituted for the two arms of a Wheatstone bridge, one arm being of a bright red copper color and the other much darker, the resistance of each arm being slightly more than 30 ohms. The other two arms were formed by putting a sliding contact on a manganin wire.

With this screen placed about 4 in. from a tungsten lamp and adequately protected from air currents, it was found possible to rate a tungsten lamp consistently many times in succession within a maximum range of 6.5 volts. The sensibility of the galvanometer used was 0.000001 amp per division, and the source of current was a single dry cell with several thousand ohms in series.

A later form of the instrument contained four screens of copper wire 0.0023 in. in diameter wound on a frame of glass rod about 6 in. square. These screens were placed one behind the other, alternate screens being blackened, and each screen formed one arm of the bridge, the necessary adjustment being obtained by a small variable resistance in one arm. The "time-lag" of this arrangement was less than five seconds, a large portion of which was due to the small changes of temperature of the structure of the lamp.

This result well illustrates Dr. Ives' remark that lamps of the same radiant efficiency (as measured at the surface of the filament) are not necessarily of the same total efficiency. It should be pointed out, however, that it is the over-all efficiency which concerns the average user of incandescent lamps, and of this the instrument gives a true measure in so far as the input leaves the lamp as radiation and is not carried away by local convection.

It should be pointed out that, while this instrument deals with the entire radiant spectrum of the lamp, the same results may be obtained much more simply with reference solely to the visible spectrum. Thus the light from a tungsten or carbon lamp at 80 per cent of its rated voltage differs greatly in color from the normal light of the lamp, and the voltage which will give a definite color can be determined by a photometric comparison of the brightness of two screens of different colors illuminated by the lamp in question. In this case the visible spectrum is divided into two parts by the reflecting surfaces of the screens, and a definite ratio of the brightness of the screens corresponds to a definite spectrum and a definite efficiency for any given type of lamp.

Bloomfield, N. J. WILFRED T. BIRDSALL.

IMPROPER WATT-HOUR-METER CONNECTIONS.

To the Editors of Electrical World:

SIRS:—Referring to the article by Mr. C. A. Howell on "Improper Watt-hour-Meter Connections" in the issue of June 15, allow me to state that an article of mine on this same subject was published in *Elektrotechnik und Maschinenbau*, Vienna, March 18, 1906, and abstracted in your "Digest of Current Electrical Literature" in the issue of April 14, 1906. In my original article the complete theory was outlined and there was given a small table of connections, similar to that in Mr. Howell's article. In an abridged form the same article was published in *The Electrical Engineer*, London, March 23, 1906, and a translation in full in *L'Eclairage Electrique*, April 21, 1906.

PROF. DR. F. NIETHAMMER.
Technische Hochschule, Brunn, Germany.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Parallel Operation of Alternators.—L. Fleischmann.—A paper read before the Berlin Electrical Society in which attention is called to the effect of torsion oscillations of axles on the parallel operation of alternators. For an arrangement of two flywheels it is shown that there are two possibilities of resonance, and the correctness of the conclusions is proven by experiments with a model.—*Elek. Zeit.*, June 13, 1912.

Lamps and Lighting.

Photoelectric Cell in Photometry.—Edward L. Nichols and Ernest Merritt.—An abstract of an American Physical Society paper. It has been shown by Richtmyer that photoelectric cells containing sodium or potassium, made by the method first described by Elster and Geitel, give a current on illumination which is strictly proportional to the intensity of the exciting light through a very wide range, provided only that the quality of the light remains unchanged. The authors have recently used such a cell in determining the density distribution in the negatives obtained when photographing certain luminescence spectra, the purpose being to locate the crests of several faint and rather diffuse bands, and they find the method both convenient and reliable. The photoelectric cell—a potassium cell obtained from Müller-Uri, Braunschweig—was mounted in a light-tight box, one side of which contained an adjustable slit, so placed that light entering the slit fell upon the sensitive surface of the cell. The negative was mounted immediately in front of the slit, and was carried by a micrometer screw. A mercury lamp was used as a source of light. To obtain sufficient detail the slit was made somewhat less than 0.1 mm wide. Under these circumstances the photoelectric current was too small to be measured by a galvanometer, and it was necessary to use an electrometer. In order that the current might be indicated by the deflection of the galvanometer rather than by the rate of change of the deflection the cell was connected as shown in Fig. 1. The potassium terminal of the cell K was connected to one pair of quadrants of the Dolezalek electrometer and also, through a resistor R, to earth, the other terminal of the cell being connected to the positive side of a 110-volt circuit. The resistor R consisted of a capillary tube containing absolute alcohol, and could be adjusted by varying the depth of immersion of the wire

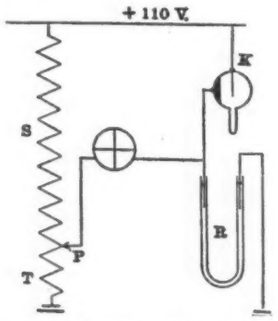


Fig. 1—Connections of Photoelectric Cell.

leading to the earth. Since a small current passed through the cell even without illumination, it was found convenient to connect the other pair of quadrants to P, and by adjustment of the resistance of S and T to bring the two pairs of quadrants to the same potential when the cell was in the dark. The deflection of the electrometer upon illuminating the cell was then a measure of the intensity of the light entering the slit. Readings could be taken with great rapidity. In one instance, for example, over 400 readings were taken covering the range from 4338 to 5790 Angstrom units in less than an hour. Since the quadrants of the electrometer are permanently connected to earth through the resistors R and T the instrument is almost entirely free from electrostatic disturbances. The fact that the quantity sought is measured by a deflection, rather than by the rate of change of a deflection, leads to a considerable increase in the convenience with which observations may be made; while the sensibility of the method may be made many times greater.—*Phys. Review*, June, 1912.

Electric and Kerosene Lighting.—J. Singer.—An account of tests made in the laboratory of the Frankfurt electric station on the comparative cost of electric and kerosene lighting. In the extended tests an average kerosene consumption of 3.2 grams (0.1 ounce) per hefner candle-hour was obtained, costing from 0.44 to 0.75 cent according to the quality of kerosene used. Metallic-filament lamps consume 1.1 watt per hefner candle, hence, with an average price of 11 cents per kw-hr. the cost of energy for a 25-cp lamp is 0.3 cent per hour. Electric light is, therefore, much cheaper than kerosene light.—*Elek. Zeit.*, June 6, 1912.

Traction.

Single-Phase Traction.—H. Behn-Eschenburg.—An English translation of his recent German article on the work of the Oerlikon Company in single-phase traction. After referring to the excellent results obtained from the first 2000-hp locomotive, built in accordance with Oerlikon practice for the Loetschberg line, the main features of the new 2500-hp locomotives for the Berne-Loetschberg-Simplon Railway are described. A substantial improvement consists in the use of simple drum-type controllers for regulation of speed and pressure.—London *Electrician*, June 28, 1912.

Installations, Systems and Appliances.

German Central-Station Statistics.—Emil Schiff.—An article giving some notes on the statistics issued by the German Association of Central Stations, with special reference to amortization. The number of pure direct-current stations decreases continually because local stations develop into transmission systems. The number of stations which buy electricity in bulk is increasing.—*Elek. Zeit.*, June 6, 1912.

Automatic Pressure Regulators.—S. J. Watson.—A paper read before the British Municipal Electrical Association. Automatic pressure regulators should be at all times and under all conditions completely automatic in their action, but few are. It is, however, usually possible to provide an independent device to insure that the regulator will be cut out of use if a certain range of regulation is exceeded. The majority of the instruments used for the purpose of controlling the pressure of supply consist either of a movable iron core inserted in a shunt coil, or of a movable shunt coil which can rotate between the poles of a permanent magnet, the shunt coils in both cases being excited from the busbars. If the busbar pressure falls, the movement of the core or the shunt coil is in one direction, and if the busbar pressure rises the movement is in the other direction. With ordinary changes of pressure the movement produced and the power exerted is quite small; it is therefore necessary to magnify the movement or to use relays in order to obtain a sufficient range of regulation, and the mechanical power required to operate an auxiliary regulating device. By means of the auxiliary device, which

may consist of a small motor or solenoids, regulation is obtained by (1) moving the switch which varies the resistance in circuit with the field winding of the generator; (2) varying the field of a small, separate exciter supplying field current to the generator; or (3) diverting more or less of the field current of the generator. When a number of generators are run in parallel, use may be made of a regulator controlling them all, in which case any variation in load is distributed equally over all the plant, or with one generator only, which will then deal with the fluctuations and allow the other plant to run at constant load. Regulators are usually provided with hand adjustment, to enable the busbar pressure to be varied when necessary to suit the load conditions.—London *Electrican*, June 21, 1912. In the extended discussion which followed H. M. Taylor described in detail the progress of regulation in Middlesbrough and A. H. Watson gave some details of the Tirrill regulator.—London *Electrician*, June 28, 1912.

Electric Water Heater.—W. R. COOPER.—An illustrated article on the problem of electrically heating domestic water supply. The author discussed a form of heater in which part of the water is heated directly by electric energy and the remainder is heated indirectly from the first part. The arrangement is shown in Fig. 2, in which *A* is an inner cylinder containing the portion of water that is heated directly by an immersion heater *B*. The remainder of the water is contained in an outer packet *C* and receives heat from the inner cylinder. In order that the inner body of water should become sufficiently heated it is necessary to insulate thermally the inner cylinder from the packet so as to keep down the flow of heat to a suitable extent, and for this purpose an air space *D* is provided between the two vessels. The cold water is supplied at the bottom of the outer vessel; the warm water in this collects at the top and is taken through the pipes *F* to supply water to the bottom of the inner vessel as water is drawn from the top of this vessel, where the hot test water collects. The advantage of this arrangement is that the electric heating is applied to, say, one-third of the water instead of to the whole, and consequently after water is drawn the temperature is raised much more quickly than it would be otherwise. A storage system of this kind acts somewhat like a buffer battery; it smooths out the demands made upon the source of energy, and it must be suitably proportioned to

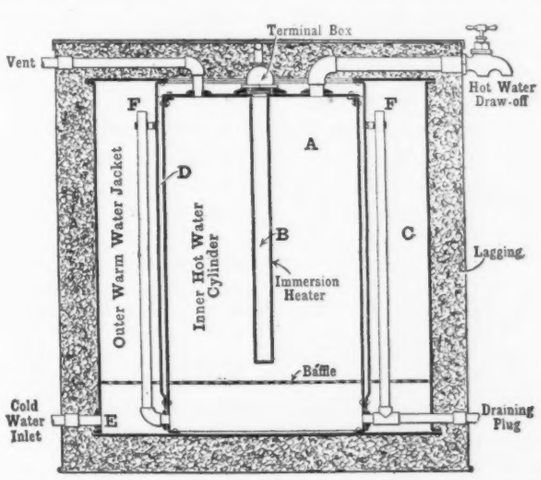


Fig. 2—Cross-Section of Domestic Water Heater for Continuous Load.

the quantity of water needed. Sometimes it may happen that an abnormal quantity of water is required; for example, on special occasions, or when visitors are staying in the house. Demands of this kind can be met, if necessary, by fitting an auxiliary heating coil which would be switched on by the consumer when desired, or controlled thermostatically. A water heater of this kind, being continuously in circuit, would preferably be connected direct to the mains, the energy not being metered, but charged at so much per month. Any auxiliary heating coil would, of course, be supplied with energy through the meter at the ordinary rate.—London *Electrician*, June 21, 1912.

Wires, Wiring and Conduits.

Pin Insulators.—W. FELLENBERG.—The first part of a very long and profusely illustrated paper read before the

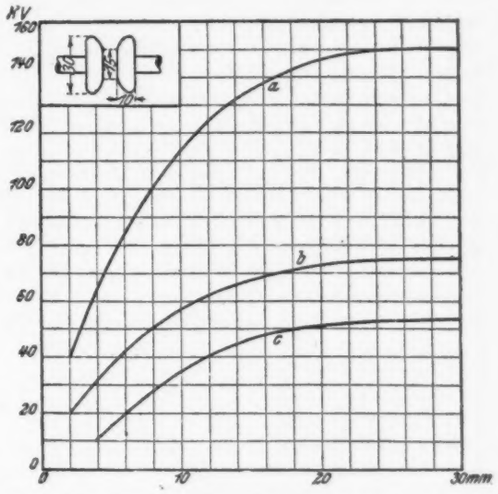


Fig. 3—Relations Between Thickness of Porcelain and Break-Down Voltage of Pin Insulators.

Berlin Electrical Society on the fundamental principles of insulator design and construction. The perforation voltage is not the only criterion of correct design, since the voltage at which the silent discharge and the brush discharge start must also be taken into consideration. General rules are given which ought to be followed in insulator design. Breakdown tests were made with Schomburg high-tension porcelain. Six hundred plates were tested, the tests being made between two plane circular electrodes rounded along the rims. In some of the tests one side of the porcelain plate was covered with tinfoil, but there was no difference between the results of the tests with and without tinfoil. Nor was there any difference between glazed and unglazed porcelain plates, nor between tests in air and oil. Curve *a* in Fig. 3 gives the breakdown voltage in kilovolts as a function of the thickness of the porcelain in millimeters (1 mm = 39.37 mils). The breakdown voltage does not increase proportionally to the thickness. A thickness of porcelain above 18 mm (0.7 in.) should be used only when greater mechanical or dielectric strength is required. In tests of porcelain care must be taken not to weaken the porcelain by the applied voltage. Curves *b* and *c* in Fig. 3 give the voltages which may be safely applied. Curve *c* refers to tests in which the hollow spaces in the insulators are filled with water. The dielectric strength of the porcelain in kilovolts per centimeter decreases. Whether the decrease of the dielectric constant of the porcelain with the thickness of the plate is apparent or real has not yet been definitely established. The author deals in considerable detail with various features of the design, with the preliminary discharge which may occur in insulation, with the influence of the dimensions on the silent, brush and spark discharges, with the influence of the general design of the insulators on the discharges, and gives results of tests with different types of insulators in detail. The paper is to be continued.—*Elek. Zeit.*, June 6, 13 and 20, 1912.

Electrophysics and Magnetism.

Variation of Resistance of Selenium with Voltage.—E. E. FOURNIER D'ALBE.—A note on a recent Royal Society

paper read in London. In all dry selenium bridges an increase of voltage always produces an increase in the electrical conductivity, and the main result of the present investigation is to show that the potential effect is proportional to the logarithm of the voltage in all selenium bridges having graphite electrodes and for all emfs above 1 volt. The logarithmic law was found to hold in the seventy bridges tested and was verified for a voltage as high as 220. The author discusses the arguments against the various theories of the potential effect, and concludes that it is not very wide of the mark to compare the conductivity of selenium with that of a gas, due to ionization by collision modified by a subsequent recombination of the ions.—London *Electrician,* June 28, 1912.

Magnetic Properties of Alloys.—An account of a symposium of papers presented before the Faraday Society on the magnetic properties of alloys. E. Gumlich discussed the magnetic properties of iron-carbon and iron-silicon alloys, E. Wedekind magnetism and stoichiometry, J. G. Gray and A. D. Ross discussed magnetism at low temperatures, A. D. Ross as well as E. Take and F. Heusler discussed Heusler alloys, S. Hilpert and E. Colver-Glauert the magnetism of nickel and manganese steels, S. Hilpert and T. Dieckmann the magnetism of manganese compounds, and P. Weiss the magnetism of iron-nickel, iron-cobalt and nickel-cobalt alloys.—*Met. and Chem. Eng'ing,* July, 1912.

Permanent Magnets.—S. P. Thompson.—A lecture held before the (British) Institution of Electrical Engineers. After some remarks on the influence of micro-structure and temperature on the magnetic properties of steel the author laid emphasis on the advantage of using long bars for magnets, owing to the demagnetizing effect of the poles in the case of short magnets. He then discussed cooling curves and recalescent points and emphasized the effect of heat treatment on magnetic properties. Thus he stated that a better effect could be obtained by heating tungsten steel to a high temperature and letting it cool to a point just above the lowest recalescence point before quenching.—London *Electrician,* June 21, 1912.

Units, Measurements and Instruments.

Crystal Rectifiers and Wave Detectors.—Robert H. Goddard.—An account of an experimental investigation with reference to the fact that the resistance to the flow of current across the contact of dissimilar solids depends upon the direction of the current and the use of such contacts as rectifiers and electromagnetic wave detectors. A large number of experiments with currents up to 9 amp suggested the necessity of using contacts of as nearly chemically clean surfaces as possible. By means of a glass apparatus which could be evacuated to a Crooks vacuum, it was possible to break or file the ends of the substances and metals in vacuo, and measure the conductances. Proceeding in this way it was found that tellurium and pure silicon lost most or all of their power to produce rectification when cleaned, as above, in vacuo, hydrogen, nitrogen, and carbon dioxide, but behaved in oxygen as in air. Fused silicon and galena gave rectification in vacuo and all gases; the former always, the latter often. Galena and natural graphite were found uncertain even under ordinary conditions. Copper filings produced and examined in vacuo and hydrogen did not show the anomalies of conduction manifested in air and oxygen. Aluminum and magnesium gave uncertain results. Galena powdered in vacuo by filing showed the same anomalies as in air. The experiment with copper filings supports the theory of Eccles, that the deviation from Ohm's law of the coherer is due to turning of the particles, due to electrostatic forces, so that the long axes point in the direction of the current. Although Ohm's law was practically obeyed, there were sudden increases in conductance on raising the voltage. There was little evidence of turning in general, however, unless a film of oxide was present—although Hertz waves greatly increased the conductance. From his experiments the author concludes that rectification is of two kinds, "surface" and "body" rectification, and that the former takes place with pure elements in an active gas, and the latter with impure elements and chemical compounds, irrespective of the nature of the gas present. Many experiments with contacts in air carrying large currents, and contacts in vacuo, showed phenomena which suggested that a film of some sort is necessary in order to have rectification. These experiments, together with an oscillogram of a number of silicon-steel rectifiers in parallel indicate that the action of the solid rectifier is like that of the aluminum valve, or electrolytic rectifier; that is, a film is formed which hinders the motion of certain ions, with this difference, that, in solid rectifiers the film is broken down by heat, or sparking, so that some current usually flows in the direction of higher resistance.—*Phys. Review,* June, 1912.

Calibration of Wave-Meters.—G. W. O. Howe.—An abstract of a British Physical Society paper. Wave-meters consisting of a variable air-condenser and a set of coils can be calibrated approximately by calculation from the known capacity of the condenser and the inductance of the coils. The most probable source of error is that due to the capacity from turn to turn of the coil. This can be allowed for with sufficient accuracy for all practical purposes by finding the natural frequency of the coil alone and calculating its effective or self-capacity on the assumption that the whole steady-current inductance of the coil is effective even when it is oscillating freely. This capacity is then added to the capacity of the air-condenser. Another method of finding the required correction by comparison of the results obtained on the overlapping portion of the ranges of two coils is also described. The correction can be made small by suitably designing the coils.—London *Electrician,* June 28, 1912.

Maximum Sensibility of a Duddell Vibration Galvanometer.—H. F. Haworth.—An abstract of a London Physical Society paper. The maximum sensibility of a moving-coil vibration galvanometer as a voltage detector is obtained when the flux through it is so adjusted that the back emf of the coil is equal to its *IR* drop; then the back emf is equal to half the applied voltage, and the current is in time-phase with the applied voltage. Increases of current sensibility of about 30 per cent at 200 cycles and 40 per cent at 1000 cycles were obtained on running the instrument in a vacuum, thus showing that a large part of the mechanical work produced was used in overcoming the molecular friction of the system.—London *Engineering,* June 28, 1912.

Telegraphy, Telephony and Signals.

High-Frequency Generator for Wireless Telegraphy and Telephony.—E. F. W. Alexanderson.—Heretofore the spark method has been used almost exclusively in wireless telegraphy. A far more rational basis was, however, provided by the invention of a 500-cycle alternating-current generator. A special form of such a generator is described which was developed by the author from a standard two-pole direct-current generator. The author emphasizes that further developments of high-frequency engineering must lead to the giving up of the principle of damped oscillations and to the introduction of a consequent system of undamped oscillations on the basis of the direct production of high-frequency currents by special generators. The author shows how such a new generator may be designed with the aid of unipolar induction and gives details of construction of a generator with interpoles which, in spite of very high speed, is quite reliable in the production of frequencies up to 200,000 cycles. The success of this design is based not only on a very simple mechanical construction, but on a new winding system which permits one to decrease the high number of poles in the armature to two-thirds of the number required with the usual winding system.—*Elek. Zeit.,* June 27, 1912.

Miscellaneous.

Convention of German Association of Electrical Engineers.—ZEHME.—An account of the twentieth annual convention of the German Association of Electrical Engineers held in Leipzig from June 5 to 8. After a number of speeches of welcome the president, Dr. Budde, gave in his address a review of new advances made in electrical engineering during the past year. Dr. Gisbert Kapp then transmitted the greetings of the British Institution of Electrical Engineers and, as representative of the English Section of the International Electrotechnical Commission, he presented to Dr. Budde, the president of the commission, a portrait of Faraday. Dr. Reichel delivered a lecture on the training of electrical engineers. The general secretary, Mr. G. Dettmar, reported that the association had twenty-two local sections and 5000 members and that its property amounts to $19,000. At the conclusion of this first session the exposition of applications of electricity in house, workshop and agriculture was opened. In the second session of the first day the following papers were read. Dr. Teichmüller spoke on the use of peat as fuel for electric-power plants, with reference to the Aurich station, where the fuel is peat and the electrical energy is employed for drainage and for power purposes in making the peat district available to agriculture. The peat consumption is 2.5 kg (5.5 lb.) per kw-hr.; the cost is 0.31 cent per kw-hr. Mr. A. Rittershaussen presented a paper on heat storage, Mr. F. Girard a paper on a new alternating-current quartz lamp, Prof. R. Hundhausen a paper on the standardization of fuses. At the beginning of the session of the second day Mr. Geheimrat Christiani, of Berlin, was elected president of the association and Dr. Budde was made an honorary member of the council. The next convention will be held in Breslau. Dr. G. Klingberg read a paper giving the fundamental principles which must be considered in the design of large steam-driven, three-phase stations. Mr. F. Bartel spoke on the use of low-grade fuels (lignite and peat) for the supply of Germany with electrical energy. Mr. E. F. G. Pein discussed the proposed power plant at Husum which is to utilize the power of the tides. Dr. A. Schwaiger discussed the use of storage batteries or heavy flywheels for equalizing the load curve in large power plants. Several visits were paid to the municipal electric station, to the Kulkwitz power plant, the factory of Ad. Bleichert & Company and the publishing house of J. J. Weber.—*Elek. Zeit.*, June 27, 1912.

British Municipal Electric Association.—A report of the 17th annual convention held at Harrogate, Leeds, and Middlesbrough. An account is first given of the different plants visited, including the generating stations at Harrogate and Leeds, the Leeds tramway system, the power house of the Cargo Fleet Iron Co., the Middlesbrough transporter bridge, the Middlesbrough Corporation substation, the Newport waste heat station, the works of Sir B. Samuelson & Co., and the works of Dorman, Long & Co.—London *Electrician*, June 14, 1912.

British Municipal Electrical Association.—A continuation of the convention report. In his presidential address G. Wilkinson said that on account of the advent of the tungsten lamp gas is no longer a serious competitor in new districts for internal lighting. For side-street lighting, where the local authority controls both the gas and electricity undertakings, the economy of changing from gas to electricity, excepting in new streets, has yet to be demonstrated. Where, however, the local authority owns the electricity works and a company owns the gas works, there are probably few cases where the change cannot be effected with a saving to the taxpayers and an improvement in the lighting. The author further discussed service cables, pressure regulation, publicity and advertising, and various possibilities of increasing the economy of steam-driven generating stations. The other papers are abstracted elsewhere in the Digest.—London *Electrician*, June 21, 1912.

British Municipal Electrical Association.—An account of the annual business meeting. Mr. C. E. C. Shawfield, of Wolverhampton, is the new president.—London *Electrician*, June 28, 1912.

Limitation of Rate Relief from Trading Profits.—S. L. PEARCE.—A (British) Municipal Electrical Association paper. The author emphasizes the need which exists for a definite pronouncement from the British Parliament as to the extent to which municipalities should be permitted to lower the rates by reason of the profits of their trading departments, electrical and gas departments, etc.—London *Electrician*, June 21, 1912.

Electrical Accidents.—G. SCOTT RAM.—The annual report of the chief inspector of British factories and workshops. There were 382 accidents at electric generating stations and substations in 1911, of which 308 were non-electrical and 74 electrical. There were 290 electrical accidents in factories other than electric stations. Details of some of these accidents are given. A diagram is given which shows that while the use of electrical energy for motive power in factories is steadily increasing during the last ten years in Great Britain, the increase of electrical accidents has been checked since 1907 so that since that year the number of electrical accidents has remained about stationary.—London *Electrician*, June 28, 1912.

Book Reviews

ELECTRIC IGNITION. By Forrest R. Jones. New York: John Wiley & Sons. 420 pages, 294 illus. Price, $4.

A reference book on the principles, construction, operation and maintenance of electric ignitors as used in automobiles and gas engines generally, written mainly for persons fairly acquainted with mechanism but not acquainted with electrical apparatus. About two-thirds of the book are devoted to explaining the electrical features of igniters and the remaining third to the mechanical features.

The illustrations of machine parts and the diagrams of connections are clear and well executed. The technical treatment is intended for the ordinary mechanic or the driver of an automobile and not for the electrical engineer or the physicist, so that the definitions of electrical terms are naturally more practical than rigid. A large number of working systems of electric ignition are described in detail. The book will be useful to constructors of ignition apparatus, to chauffeurs and to all who desire to acquaint themselves with the elements of electric ignition.

THE LAW OF THE AIR. By Harold D. Hazeltine. London: University of London Press. 152 pages. Price, $

This book is a publication of three lectures given at King's College, London, in December, 1910, by the author for the University of London and at the request of its Faculty of Laws. The book is readable to the layman. It does not limit its interest to the legal profession.

The author takes the position that although the risks and dangers of airships in the overhead region are much greater than those of hertzian waves, and therefore call for separate legislation, yet he considers that fundamentally the law applies to both in the same manner, broadly speaking. A state has the right to grant or deny the use of its air space either for the passage of airships or for the passage of hertzian waves; or both. Granting the rights of nations or communities to offer or deny the freedom of their air space to aviators or wireless telegraphers, it would be much more difficult to establish the right in the case of the aviators than in the case of the telegraphers, especially if the sending and receiving stations were both ex-territorial. The book will be of value to all interested in international action on the use of the atmosphere.

New Apparatus and Appliances

5000-KW TURBO-ALTERNATOR.

The County of London Electric Supply Company has recently installed a new 5000-kw turbo-alternator, which possesses certain interesting features. The turbine is of the six-stage Curtis type and has a normal rating of 5000 kw, with an overload range of 50 per cent when operating condensing, and is able to carry three-quarters load when exhausting to the atmosphere in case of emergency. The high-pressure steam is admitted to the center of the turbine, passing through two stages in succession toward the governor end and, returning through passages to the center of the casing again, passes through the remaining four stages in the other direction to the exhaust.

The shaft packing employed is of the carbon ring type and is arranged to make possible its examination or renewal without the tedious operations of dismantling any part of the turbine casing.

The two bearings are of the spherically seated self-aligning type and contain passages for cooling-water circulation. The centers of the bearings are only 8 ft. 6 in. apart, which is a desirable feature in turbines constructed on the Curtis principle. The shortness of the shaft renders it possible, without employing extreme dimensions, to have the running speed considerably below the critical speed so that no danger from whipping is to be feared when starting up or shutting down.

Steam is admitted to the turbine through several controlling valves, each of which regulates the supply to a separate group of high-pressure nozzles. These valves are opened in succession as the load comes on by means of a rotary cam shaft actuated by a hydraulic motor controlled by the governor. As the governor has to move only a small pilot valve, use is made of a very sensitive governor, and this type of gear is stated to give excellent results, a speed variation of only 2 per cent between full load and no load being obtained. At the same time the gear is said to be remarkably steady and no hunting occurs.

The generator has a normal rating of 6250 kva and delivers this energy in the form of two-phase, 50-cycle current at 2200 volts. The rotor has four poles. The machine is capable of carrying a load of 7800 kva, or 25 per cent above the normal rating, for two hours.

In the rotor the exciting windings are carried in closed slots so as to avoid the use of wedges or other loose parts. At the ends of the rotor these windings are supported by massive rings on the outside, whereas on the inside they are freely exposed to the air in order to insure proper cooling. The distribution of the winding in a large number of slots insures not only that the stresses are low but also that the exciting coils are provided with ample cooling space. In order to facilitate transport and to allow easy dismantling to be effected, the stator has been made in two parts. The two generator bearings are independent of the turbine bearings and, being driven through a flexible coupling, the generator is capable of running satisfactorily even when slightly out of alignment. The exciter is driven through a flexible disk coupling contained within the alternator main-bearing housing and is also independent of exact alignment.

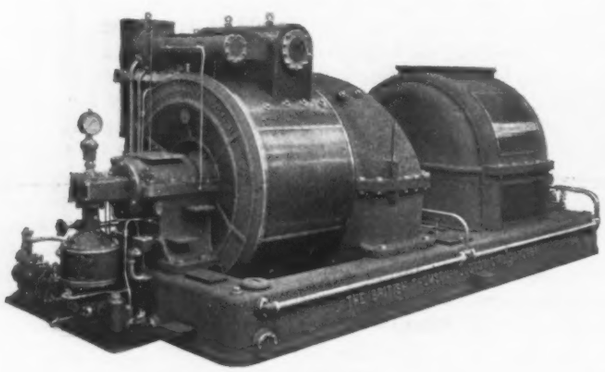


Fig. 1—5000-kw Turbo-Alternator.

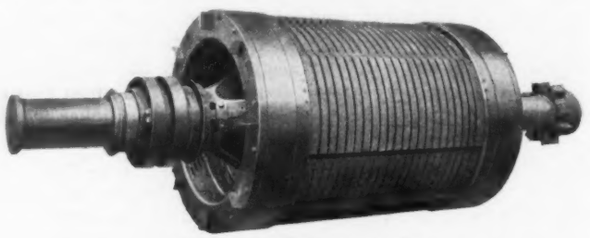


Fig. 2—Rotor of Generator.

Ventilation is effected without the use of any external fans, the rotor itself acting as a blower. The air for cooling purposes is led through ducts in the base plate and after circulating through the machine is expelled through an opening in the top of the stator frame. Before entering, the air passes through a filter, to prevent dust or other impurities from accumulating in the machine. These filters consist of a number of box units, each box containing a continuous length of filter cloth stretched on suitable frames. The arrangement of the boxes is such that any one can be readily withdrawn and a clean box substituted, if necessary while the machine is running, and the size of the boxes is such that they can be easily handled. After a box has been withdrawn the cloth can be changed at the operator's leisure.

The stator frame is provided with planished steel panels which can be readily taken off and allow access to the inside of the machine for inspection and cleaning purposes.

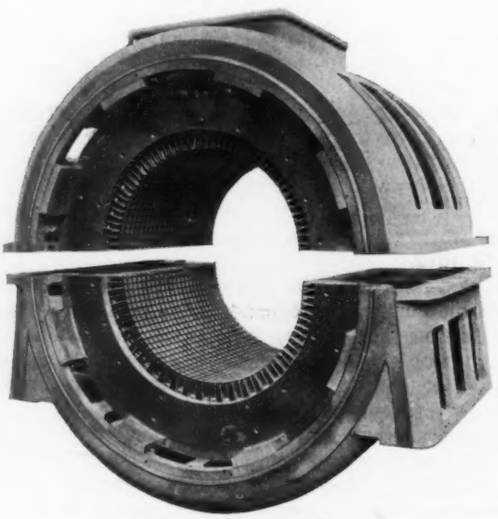


Fig. 3—Stator of Generator.

The dimensions of this turbo-alternator are 10 ft. 6 in. wide by 29 ft. long by 10 ft. 3 in. high. At a rating of 5000 kw, this gives 16.42 kw per square foot of floor area. The manufacturer is the British Thomson-Houston Company, Ltd., Rugby, England.

MOTOR-DRIVEN REFRIGERATING PLANT FOR ICE-BOX.

The motor-driven refrigerating outfit illustrated herewith is arranged to be mounted on top of the standard household refrigerator or ice-box, the ice chamber of which becomes the container for the brine-immersed expansion line of the miniature ammonia system. The equipment installed in the

Motor-Driven Household Refrigerating Outfit.

demonstration room of the manufacturer, the Auto-Electric Refrigerating Company, 243 Railway Exchange, Chicago, comprises a 0.25-hp motor driving the ammonia compressor which is capable of producing 200 lb. of equivalent refrigeration per day. The ammonia charge of the compressor line is cooled by passing it through the coils of the condenser tank, which is supplied with fresh hydrant water through a 0.5-in. pipe connection. The ammonia, at 150-lb. pressure per square inch, is then delivered down to the expansion coils which are contained in a rectangular tank in the ice chamber of the refrigerator. This tank, about the size of a cake of ice, thus provides all required cooling action for the contents of the refrigerator.

The temperature in the various chambers is also held constant, within a couple of degrees of 45 deg. Fahr., by a thermostat which controls the operation of the compressor motor. As soon as the required low temperature is attained in the lowest level of the refrigerator, the motor is automatically shut off, and when the temperature again rises the thermostat closes contacts to the automatic starting box. In ordinary use the motor is required to run about two-thirds of the time, it is declared, thus leaving a margin of cooling action to be drawn upon where heavy service is demanded, the refrigerator contents are frequently changed, etc. Since the brine in the expansion tank has considerable storage capacity, the control equipment is required to operate only at long intervals to maintain equilibrium. A diaphragm valve on the ammonia line puts the water circulating system also under the control of the thermostat, shutting off the water supply when the compressor is not in operation.

Besides providing refrigeration, the outfit described also manufactures ice in sufficient quantity and in a form suitable for table use. Suspended in the brine of the expansion tank are a pair of flat freezing cans measuring approximately 10 by 12 by ¾ in. in inside dimensions. These can be frozen solid in an hour, it is asserted, the ice being later freed by holding the can under the hot-water faucet. Ten to 50 lb. daily can be made in this way. In the form of these flat cakes the ice is, of course, easily broken into sizes for the table.

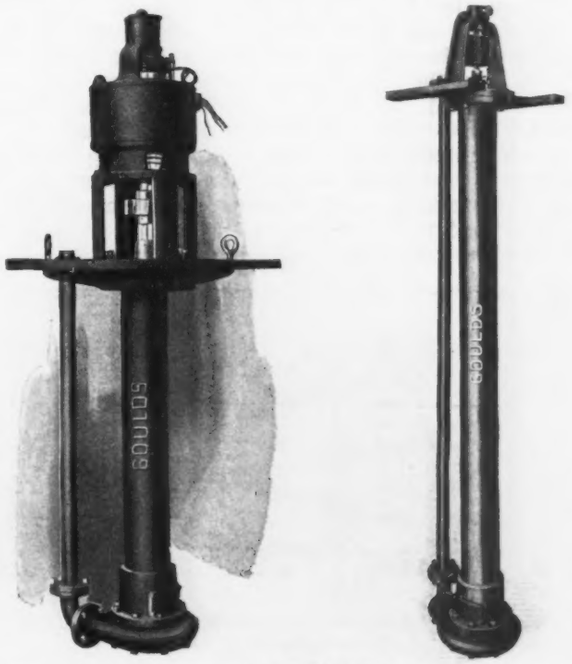
The metal parts comprising the compressor outfit weigh 156 lb. The ammonia charges are added from small steel cans arranged with screw connection to the compressor line. Each charge is enough to operate the plant six months, and may be renewed at a cost of $1.00. The radiation from the metal sides of the expansion tank being substituted for the cold moisture of ice, the contents of the chambers are kept thoroughly dry, thereby securing the well-known advantages of mechanical refrigeration. No special wiring is required for attaching the motor, and the apparatus is made in sizes to fit any ice-box.

MOTOR-DRIVEN CENTRIFUGAL SUMP PUMP.

For the purpose of supplying the demand for an automatically controlled pumping outfit, for draining basements, handling domestic sewage, pumping out bilges, etc., where the liquid collects in a sump, the Goulds Manufacturing Company, Seneca Falls, N. Y., have developed a new centrifugal sump pump.

The equipment shown in Fig. 1 consists of a vertical electric motor direct-connected to a single-stage side-suction pump. The pump is connected to a cast-iron pit cover by a rigid pipe column. This cover also acts as a support for the motor pedestals. The shaft is inclosed by the column which connects the pump to the cover and is, therefore, protected from the liquid in the pit. A cover-plate on the flange which connects the pump and the supporting column permits inspection of the stuffing box.

The motor is controlled by a starting device, actuated by a float in the sump. When the liquid rises to a certain

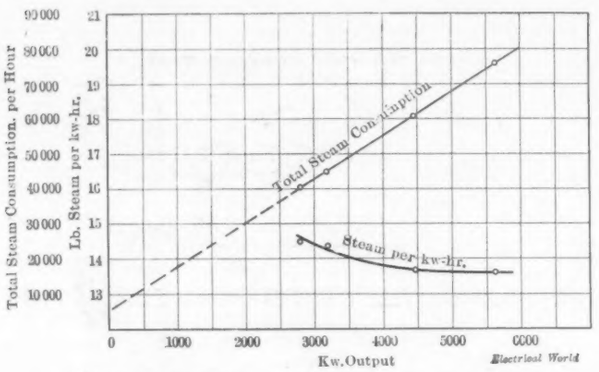


Figs. 1 and 2—Centrifugal Sump Pump for Direct Drive and Belt Drive, Respectively.

level and the float is lifted enough to close the switch the motor is started. It continues to operate until the sump is nearly empty, when the float drops back to the position where it opens the switch. For service where electric energy is not available a similar pump has been developed, equipped with a pulley for belt drive by a gasoline engine or other power. This pump is shown in Fig. 2.

TEST OF 5000-KW TURBO-GENERATOR.

The results of a test on a 5000-kw Curtis turbo-generator installed at the City Road Station of the County of London Electric Supply Company, Ltd., are shown in the accompanying illustration. At a load of 4500 kw the steam consumption was 13.7 lb. per kw-hr., and at 5600 kw it was 13.6 lb. The manufacturers claim that these results are particularly good for a turbo-generator of this capacity, since the degree of superheat is not as high as that employed when the highest efficiencies are desired. The results of this test were obtained through the courtesy of Mr. C. P. Sparks, chief engineer of the County of London Electric Supply Company, Ltd. The equipment was built by the British Thomson-Houston Company, Ltd., Rugby, England.

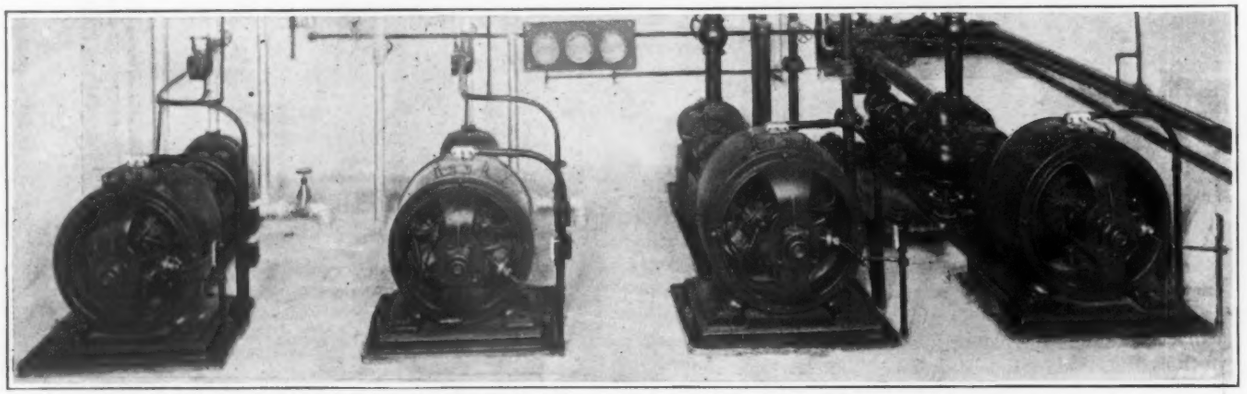


Steam Consumption of 5000-kw Turbo-Generator.

TELEPHONE TRANSMITTER AS SPEED INDICATOR.

An original use is made of the telephone transmitter in connection with four direct-current motors driving water pumps for heating and water system in the general office building of the Fort Wayne Electric Works. The motors are controlled from a general switchboard remotely located, and it was desirable that the engineer in charge at the switchboard should have some way of knowing whether or not the motors were working properly without going all over the building to the location of each one to find out. To accomplish this each of the motors was provided with a telephone transmitter, the mouthpiece being placed quite close to the commutator of the machine, each transmitter having its individual telephone circuit terminating in plug receptacles at the switchboard. When the engineer wishes to place a motor in service or adjust the speed he plugs a telephone receiver into the terminating receptacles in the board and is able to tell if it is operating properly by the pitch of the humming sound which the brushes of the motor make by the passing of the commutator bars, the pitch of the sound becoming higher as the speed of the motor is increased.

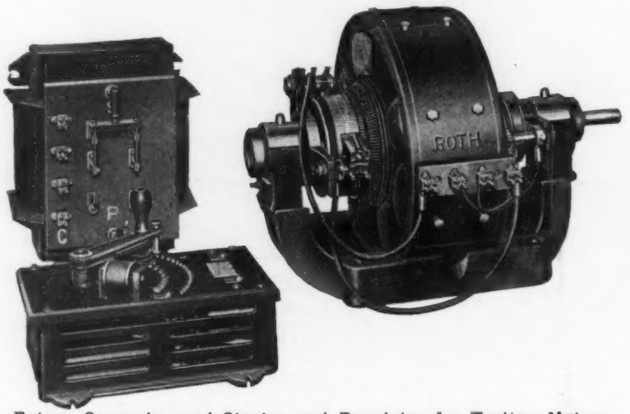
Every motor used in connection with the water, heating and ventilating systems in this modern office building is equipped with a telephone transmitter. By this method the speed of the large exhaust fan motor located on the roof of the five-story building is quite as easily noted and controlled as is that of those which operate the pumps in the basement. In fact, the experienced engineer can control the speed of any of the motors quite as accurately and as easily as if the dial of a mechanical speed indicator were registering the speed directly before his eyes.



Telephone Transmitter Used as Speed Indicator.

ROTARY CONVERTER FOR TESTING PURPOSES.

The rotary converter placed on the market by Roth Brothers & Company, Adams and Loomis Streets, Chicago, for testing small motors, consists of a standard motor frame with extended bearing bracket at each end to admit of both a commutator and collector rings on the same armature. This machine has eight poles and is wound for operation on two voltages. Thus if it operated on a 115-volt direct-current circuit, it will run at a speed of 900 r.p.m. and will give 60 cycles alternating current at the collector rings. By operating the machines on 230 volts it will run at 1800 r.p.m. and give 120 cycles at the collector rings. Other frequencies can be obtained at other speeds. A Cutler-Hammer starter and speed regulator is used to obtain the speed variation.



Rotary Converter and Starter and Regulator for Testing Motors.

To obtain the proper voltage for testing purpose, use is made of a transformer which can be arranged with a number of taps and can also be operated in series or parallel so as to obtain one or more operating voltages. The one shown in the illustration is arranged to give 110 volt alter-

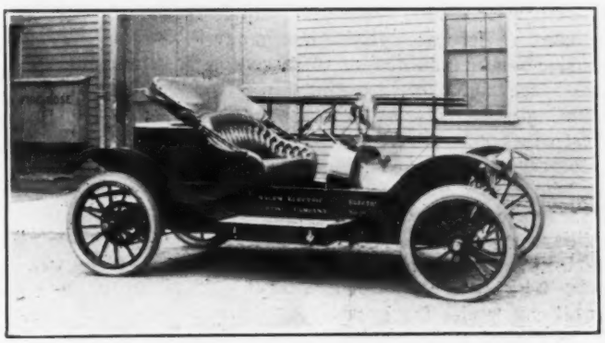
nating current at such frequencies as can be obtained from the converter. Several taps are also shown, which provide a small variation from the normal voltage.

ELECTRIC VEHICLE FOR CENTRAL STATION.

In the electric roadster adapted to street patrol work, used by the Salem Electric Lighting Company, Salem, Mass., the large box back of the seat does not contain a battery, but is used for storing arc-lamp globes, incandescent lamps, electrodes, etc. Its dimensions on the inside are 32 in. long, 23¼ in. wide and 16⅞ in. high. In addition each running board is boxed to give inside dimensions of 35 x 12 x 5¼ in., so that the storage space is ample, and yet is inconspicuous and does not add wind resistance.

It will be noted that there is carried on the car a two-section ladder, which is 9 ft. when closed and 18 ft. when extended, and a special movable searchlamp on the dash board which can be pointed at the top of a pole or at any other desired object.

The roadster was manufactured by S. R. Bailey & Company, Amesbury, Mass. It is said to be capable of maintaining high speed for many miles. It is equipped with sixty



Electric Roadster for Central-Station Service.

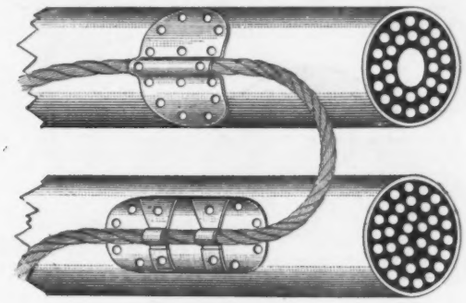
Edison cells and at the average speed of 20 miles an hour up and down hill on fair roads can cover from 60 to 80 miles on one charge of battery. It is stated that with a larger equipment of battery, namely, fifty-two cells, cars of this model in the service of the Edison Electric Illuminating Company of Boston have been driven over roads with ordinary grades a distance of 100 miles in less than five hours.

ATTACHING PLATES FOR GROUND WIRES.

To provide a convenient means for attaching bonds or grounding wires to cable sheaths or piping the attaching plates and bond wire shown in the accompanying illustration have been placed upon the market by T. J. Cope, Philadelphia. These are made in the two styles shown, the one with the rigid bond wire connection being manufactured in two standard sizes. They are furnished with bond wire of any desired size and length.

The plates are made of copper, perforated as shown, and are completely covered with a film of solder for protection against corrosion, as well as for convenience in application. In applying the plates the surface of the cable sheath which is to be protected is scraped clean at the point of attachment, the plate bent to fit the contour of the cable sheath and the turned plate sweated on by using a moderately hot soldering iron. The plates are made sufficiently thin to be easily bent as required by the pressure of the fingers, and the perforations enable an even and continuous solder joint to be made over the whole surface of the plate in contact with the cable sheath. The standard form of bonding wire furnished with the plates is a ¼-in. stranded copper cable composed of forty-two wires, each of which is separately covered with solder mortar to prevent any local electrolytic action which might be set up between exposed copper and the other metals under the influence of moisture.

The lower one of the two types of plate shown in the

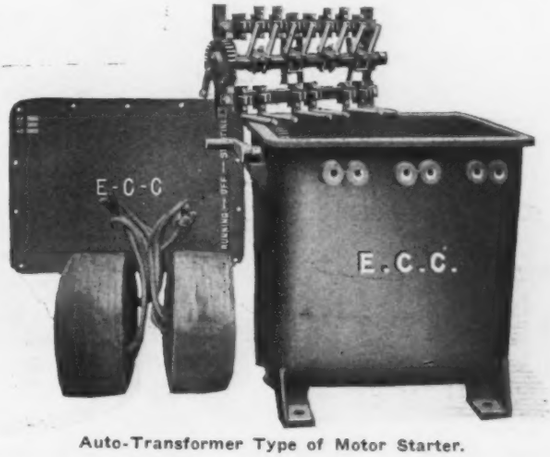


Ground Wires Attached to Cables.

illustration is provided with a pair of slips attached at one end to the plate. These are bent over the bond wire and their ends inserted in slots in the plate. This type is therefore adjustable to any size of wire and can be applied very conveniently to the cable sheath before the bond wires are connected to it.

AUTO-TRANSFORMER TYPE OF MOTOR STARTER.

An oil-immersed auto-transformer starter for two-phase or three-phase motors of the squirrel-cage type has recently been placed on the market by the Electric Construction Company, Ltd., Wolverhampton, England. It consists of a revolving-type switch with auto-transformers, inclosed in a substantial iron tank filled with oil. Both the switch and the transformers are completely immersed. An external handle is provided for operating the switch, and an indicator shows the three positions, namely, "off," "starting" and "running." Insulating bushings, as shown in the figure, are provided in the side of the casing above the oil level to receive the connecting cables. All contacts are made of wrought copper and are renewable; they are mounted upon mild steel bars with mica insulation The



Auto-Transformer Type of Motor Starter.

scheme of connections is such that the auto-transformers are disconnected when the switch is in the "off" position, and their circuit is open in the "running" position. The transformer coils are provided with taps for furnishing various voltages, in order to provide some range of choice to suit varying conditions of installation. When desired, a flame-proof type of case can be provided for mine use.

DISTANT-DIAL AMPERE-HOUR METERS.

A distant-dial amp-hr. meter has been developed to meet the demand for a meter in which the recording dial may be placed at any desired point, principally for use on electric vehicles. The meter, corresponding in construction and operation to a standard amp-hr. meter, except for its recording train, may be placed beneath the seat if the space allows, or it may be attached by a suitable support

Fig. 1—Flush-Type, Distant-Dial Ampere-Hour Meter.

directly to the chassis of the vehicle. The dial mechanism, requiring a space of about 3¾ in. in diameter, is so designed that it may be placed at any desired point within the body of the vehicle, and in any position, vertical, horizontal or angular.

The contact train in this meter takes the place of the usual recording mechanism, and instead of driving a hand to show directly on a dial the condition of the battery, it closes a contact which operates one of two electromagnets in the distant dial mechanism. The contact mechanism is so designed that it closes the circuit to one contact on charge and to the other on discharge of the battery. The arrangement is such that in case of a failure of the dial mechanism to operate on account of a break in the connecting wires between the meter and the dial, the rotation of the meter proper will not be stopped, as the wheel driving the contact train will escape past the lever or bar, by which the contact is operated in each direction.

In the dial mechanism are two iron-clad electromagnets facing each other, and operating upon a rocking arm or lever so that the motion imparted to this will move the dial hand forward on the discharge of the battery, and backward on charge, similarly to the movement of the dial hand on a standard type amp-hr. meter.

In the distant-dial mechanism a new type of zero contact is provided, consisting of a small lever standing at the zero point and connected to a small switch within the dial mechanism, and suitably insulated therefrom. The movement of the lever over a small arc, when the indicating hand comes back to zero, closes a switch and thus the circuit to the shunt trip coil of a circuit-breaker.

This type of meter has been developed by the Sangamo Electric Company, Springfield, Ill.

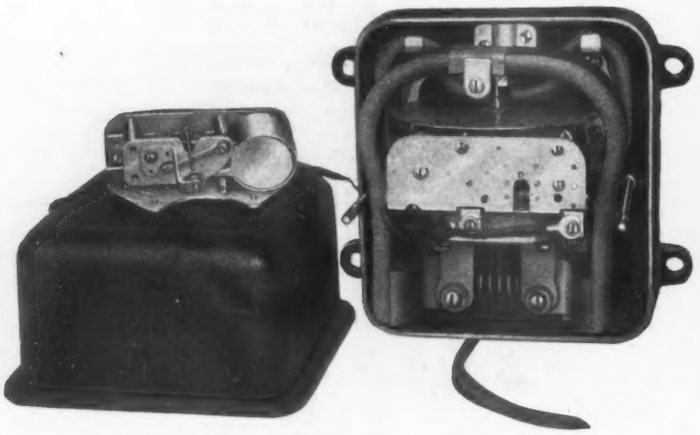


Fig. 2—Mechanism and Contact Train of Distant-Dial Ampere-Hour Meter.

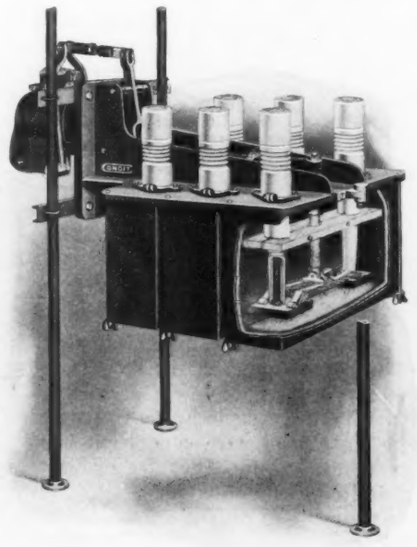
COMPACT LARGE-RATING OIL SWITCH.

On account of the increase in the size and interconnections of generating equipment the switches which heretofore have been satisfactory for operating in substations are now too small, and a demand has arisen for a compact switch which can open under a much greater flow of energy than similar switches in the past. To meet this demand the Condit Electrical Manufacturing Company, Boston, have developed a type of switch suitable for use for ampere loads up to 600 and for voltages up to and including 15,000, capable of opening extremely heavy short-circuits.

The switch is built for manual electrical or pneumatic operation, and by means of the necessary relays and transformers can be made to operate on any desired abnormal condition of the circuit which it controls. It is made for mounting either on switchboards, on framework, or in cells.

The particular switch illustrated in this article is a 500-amp, 15,000-volt, three-pole, single-throw, electrically operated switch, for pipe-frame mounting. Switches of this size can be mounted on 16-in. centers with ample clearance space and project only 25 in. from the back of the mounting plate. It is said that these switches will withstand a test of 45,000 volts.

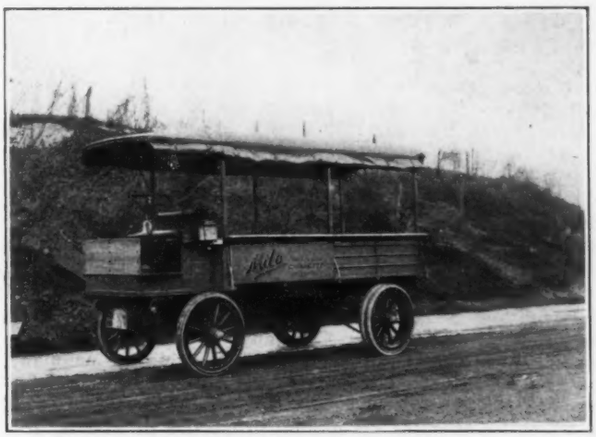
Referring to the end pole of the switch, it will be noted that the brush mechanism which carries the current is divided into two parts, each being provided with its own auxiliary contact. There are, therefore, four points at which the arc is broken, and the arc is divided up into four parts. The break of this switch takes place at the bottom of the oil can, under the greatest available oil pressure. Due to the use of a duplex brush, the mechanical strains are balanced and a space is provided between the brushes through which the oil can be forced against the arc. In order to aid the oil-blast feature, and at the same time prevent the oil from being blown out of the switch, even on extremely heavy short-circuits, use is made of a wooden deflection plate clamped on a shoulder on the porcelain insulation. Any tendency of the gases generated by the arc to throw the oil out of the can is prevented by this plate.



Large-Rating Oil Switch.

CONVENIENTLY ARRANGED ELECTRIC TRUCK.

Among the improvements introduced in the electric trucks now being built by the Lansden Company, Newark, N. J., may be mentioned the substitution of a metal for the wooden frame and relocation of the battery to render them most conveniently accessible. The battery is now contained in



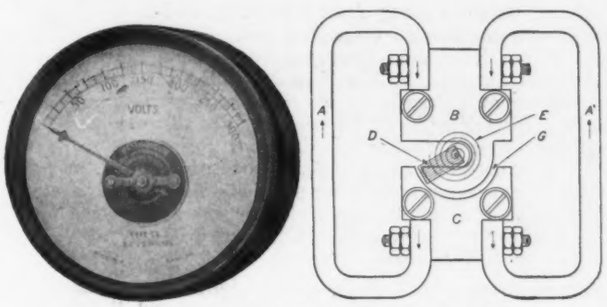
Three-Ton Electric Truck.

a tray mounted on roller bearings so that it may be slid out on either side of the car by a mere push of the hand. The batteries are of the latest improved Edison type. The car herewith illustrated is built for a load of 3 tons, but is similar to cars rated at from 1 ton to 5 tons.

DIRECT-CURRENT SWITCHBOARD METERS.

In the line of direct-current meters recently brought out by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., the magnetic circuit, consisting of two permanent magnets with pole pieces, has only one air-gap. The moving coil is pivoted at one side and the opposite side moves in this air-gap. This construction, in addition to providing one air-gap with large clearance, instead of two air-gaps with small clearances as is generally the case, also makes possible a better balancing of the pointer and results in a number of minor advantages.

Fig. 1 shows the general arrangements of the parts. The two permanent magnets are provided with soft iron pole pieces, each pole piece being common to both magnets. The moving coil is wound on a rectangular aluminum shell and incloses the end of the pole piece. This coil is so



Figs. 1 and 2—Exterior and Cross-Section of Meter.

connected that current in it tends to move the coil away from the end of the pole pieces with a force proportional to the product of the constant field of the permanent magnets and the current in the coil.

The complete magnetic circuit, including the pole pieces, is magnetized and aged as a unit, a process possible only with the single air-gap construction because the pole piece does not have to be removed to put the moving element in place. The permanent magnets are so arranged that they completely inclose the movement, thereby shielding the movement from external fields. The moving element consists of a suitable coil wound on a rectangular aluminum frame, a pointer, and a supporting framework with steel pivots. The arrangement is such that the weight of the

Fig. 3—Moving Element of Meter.

coil counterbalances the pointer as shown in Fig. 2, thus reducing the amount of additional counterweight required and making the weight carried by the pivots a minimum.

The meters are built as voltmeters and ammeters, in six types: 5-in., 7-in. and 9-in. round types, also illuminated dial, vertical edgewise, and portable types. The 7-in. round type can be inclosed in a rectangle less than 55 sq. in. in area, so that it occupies practically as little switchboard space as the smallest "edgewise" meters on the market.

STARTING AND REGULATING CONTROLLER.

A controller for medium and large size direct-current motors has been placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee. It consists of a multiple switch starter and a shunt field type speed regulator. The starting portion is similar to the multiple switch starter designed for use with large motors or with motors of medium size when the starting conditions are severe. Each of the individual levers, when closed, cuts out a step of

Motor Starting and Regulating Controller.

armature resistance, thereby accelerating the motor to normal speed. The 50-hp, 230-volt-type, field-regulating rheostat mounted above, as shown in the illustration, consists of a series of field resistance steps controlled by a single lever and serves for securing further increase in speed. Controllers of this type are built in ratings of from 10 hp to 200 hp for 115-volt, 230-volt and 500-volt circuits.

Industrial and Financial News

CONSIDERED as an index of general business conditions, the high degree of activity now prevailing in the steel trade is an almost unmistakable sign that expansion along all industrial lines is impending. Although prices have been advanced and the trend is still upward, demand shows no signs of abatement. Nearly all of the new steel contracts call for early delivery, but many of the steel companies are unable to turn out material under ninety days, while others are booked ahead for the balance of the year. An important feature of the present market is the large number of orders for railroad equipment of all kinds, and these, coming in such quantities at this time, may be construed as meaning that the roads are anticipating the transportation of unusually large crops. According to reports from the agricultural districts, yields fully equal to and in many cases in excess of normal are assured. With these excellent crop prospects, with much of the political uncertainty removed by the selection of presidential candidates, and with new high records of foreign trade behind it, the business situation is undeniably sound and of exceeding promise. With approach of crop financing, the money markets are inclining toward higher levels. Rates July 17 were: Call, 2½@2⅞ per cent; ninety days, 3½@3¾ per cent.

Organization of New Doherty Company Completed.—Directors of the Consolidated Cities Light, Power & Traction Company, which was incorporated in Delaware last month by H. L. Doherty & Company to acquire the capital stock and securities of public utility companies, as was mentioned in these columns June 22 and 29, have been chosen as follows: Henry L. Doherty, Frank W. Frueauff and Charles T. Brown, of H. L. Doherty & Company; H. H. Scott, of the Doherty Operating Company; Warren W. Foster, all of New York; Leslie M. Shaw, of Philadelphia; W. F. Hoffman, of Columbus; James Satterfield, of Wilmington, Del.; James Twitchell, of London, president of the Alabama Light, Traction & Power Company, and Laurence MacFarlane, of Montreal. The companies which the new corporation now owns or controls, a list of which was given in the *Electrical World* June 29, are subject to an aggregate bonded debt of approximately $8,689,800 of bonds, which will be retired from time to time as occasion offers. These companies will own and operate plants in twenty-one cities and in twenty-three small towns adjoining these cities, supplying a total population in excess of 400,000. For a consideration to be provided for out of the stock issue, and free of further charge to the company, the Doherty Operating Company has undertaken the entire operation of the Consolidated Cities company until the aggregate profits of the constituent companies available for dividends would, if distributed, together with any other net profits of the company, be sufficient, after paying the interest on the company's bonds, to pay 7 per cent on the common stock. After that time such a charge as may be considered reasonable will be made. In partial payment for these services, the Consolidated Cities company has given the Doherty Operating Company an option on $2,000,000 of common stock at $100 per share for five years. Net earnings of the new company for the calendar year 1913 are estimated at $400,000, of which, after deduction of 5 per cent on the $4,000,000 bonds outstanding, there would be left $200,000, or 4 per cent on the common stock outstanding. Net earnings for 1914 are placed at $500,000, and for 1915 at $600,000. Negotiations looking toward the acquisition of other properties, which will add to the net earnings, are now in progress. Proceeds of the bond and stock issues will provide for the purchase of the various properties enumerated in the June 29 number, and will also leave ample working capital. It is proposed to begin paying dividends at a minimum rate of 2 per cent per annum on the common stock during the first year, 3 per cent during the second year and 4 per cent during the third year.

National Light & Power Company (St. Louis) to Manage Missouri Traction.—On July 2 the St. Francois County Railroad, of Farmington, Mo., was purchased by the Mississippi River & Bonne Terre Railway Company, of Bonne Terre, Mo., which has placed the management of the property in the hands of the National Light & Power Company, of St. Louis. The latter, which owns and operates gas, electric, railway and water properties, will, in its capacity as supervising engineer, improve and extend the St. Francois County road and will electrify the Crawley spur of the Mississippi River & Bonne Terre Railroad. This will give the St. Francois County Railroad an entrance to the traffic center of the town of Flat River. Judson H. Boughton, president of the National Light & Power Company, will be vice-president and managing director of the St. Francois road. The property will be managed locally by A. D. Brinkerhoff, a member of the staff of the National Light & Power Company.

Transfer of Utah Properties.—It is reported that former United States Senator W. A. Clark has acquired control of the Clark Electric Power Company, of Tooele, Utah, the consideration being $90,000. This will enable the company to call in $74,000 worth of outstanding bonds and make some needed improvements. W. A. Clark owns an isolated plant by which he operates his mining properties in Tooele, and the two plants will be operated conjointly. The Clark Electric Power Company supplies electrical energy to Ophir, Stockton and Grantsville, as well as to Tooele, customers' connections numbering about 700. It is a hydroelectric plant, water being obtained from Settlement Canyon through a 16-in. pipe to a 500-hp Pelton wheel. There is also a steam auxiliary. E. W. Clark is the manager of the property and C. E. Green is the electrical engineer. Mr. Clark says that possibly the system may be enlarged by the installation of a hydroelectric plant on South Willow Creek, eight miles below Grantsville.

Control of Columbia Gas & Electric Company (Ohio) Changes Hands.—A syndicate managed by A. B. Leach & Company has purchased control of the Columbia Gas & Electric Company, which controls the Union Gas & Electric Company of Cincinnati, and leases the Cincinnati, Newport & Covington Light & Traction Company, which operates all the gas, electric and street railway companies of Covington, Newport and other cities and towns in Campbell and Kenton counties, Kentucky. The Columbia company also has large natural gas and oil holdings in West Virginia and Kentucky. It has $50,000,000 stock and $13,603,000 5 per cent first mortgage bonds outstanding. Archibald S. White, of Cincinnati, is its president. It is expected that the board of directors will be reorganized at an early date, and that representatives of A. B. Leach & Company and of J. & W. Seligman & Company, who are members of the purchasing syndicate, together with other prominent financial interests will be represented on the board.

Court Upholds Long Acre Company, of N. Y.—In a divided opinion handed down last week the Appellate Division of the New York Supreme Court dismissed a writ of certiorari obtained by the New York Edison Company to review an order made by the Public Service Commission for the First New York District on July 28, 1911, authorizing the Long Acre Electric Light & Power Company to issue $2,000,000 in stock and $4,000,000 in bonds for the purpose of financing a generating plant and distributing system with which it plans to supply electric energy in New York City. The New York Edison Company will carry the case to the Court of Appeals.

Birmingham (Ala.) Railway & Light Improvements.—Extensive additions to its generating plant and distribution system are to be made by the Birmingham (Ala.) Railway & Light Company. Double-tracking of part of its railway lines will also be done. A 10,000-kw. turbine unit has been purchased from the General Electric Company, and other new equipment to be installed includes a cooling tower and a large amount of conduit. The latter has been purchased.

Allis-Chalmers Business.—During the latter part of June orders for engines aggregating 70,000 hp in rated output were received by the Allis-Chalmers Company.

Coast Counties Gas & Electric Company (Cal.) Offering.—In connection with recent offering by San Francisco interests of an underwriting of $250,000 6 per cent cumulative preferred stock of the Coast Counties Gas & Electric Company, of San Francisco, a letter by the president of the company, John Martin, of San Francisco, gives some data of interest pertaining to its affairs. This states that the company was organized in California on March 20, 1912, and has purchased the properties of the Coast Counties Light & Power Company, the Big Creek Light & Power Company and the San Benito Light & Power Company, subject to their respective bonded debts. It has purchased all of the outstanding capital stock of the Union Traction Company, of Santa Cruz. These purchases, the payment of the floating debt and extension of the company's lines, have been financed through sale of the preferred and common stock, the bonded debt being limited to the underlying issues. The territory served by the company embraces Santa Cruz, Santa Clara, Monterey and San Benito counties, California, and extends from the towns of Morgan Hill and Ben Lomond on the north to Hollister on the south, and westward to the coast, including Santa Cruz, Watsonville and Gilroy. Net income of the constituent companies last year was $143,134 and the surplus was $73,574. At the close of the year the company had 2725 gas consumers and 4627 consumers of electric energy on its books. Its properties include a 1080-hp hydroelectric plant, a 1266-hp steam plant in Santa Cruz, and a 1000-hp steam plant at Watsonville. It also has a long-term contract with the Pacific Gas & Electric Company for such additional energy as may be required. There are 75 miles of transmission lines and 531 miles of distribution lines. The company also has gas plants in Santa Cruz, Watsonville and Hollister. The directors of the company are John Martin, president; R. M. Hotaling, vice-president; John C. Coleman, Louis Sloss, Joseph D. Grant, L. P. Lowe, and S. W. Coleman, the general manager, of the company.

New Hydroelectric Plant on Savannah River.—J. G. White & Company have been retained by the Georgia Carolina Power Company as engineers and contractors on the hydroelectric development at Stevens Creek, on the Savannah River about nine miles northwest of Augusta, Georgia. The river at this point forms the boundary line between Georgia and South Carolina and is about 2700 feet wide. The Charleston & Western Carolina Railway passes within 3.7 miles of the dam site and a spur connection will be made at a point about six miles from Augusta. The power house will be at the Georgia end of the dam, and for the ultimate installment its length will be about 360 feet. The length of the dam will be 2300 feet, the spillway section of which will be about 2000 feet long. A lock about 30 feet by 150 feet in the clear will be constructed for pole boat navigation. In the overflow section of the dam adjacent to the power line will be five waste gates about 8 ft. square. The average height of the dam will be 34 ft. Flash boards 3 to 4 ft. high are to be provided. The ultimate installation will be 18,000 kw in ten main units, with two 200 kw water wheel driven exciter units and one 200 kw motor driven exciter. The average head will be 27.3 ft. with extremes of 16 ft. and 32 ft. The present installment will include five main and two exciter units. Transmission lines will be constructed to Augusta, Ga., 10 miles, and from Augusta to Graniteville, S. C., 17 miles, making a total of 27 miles, to be operated at 33,000 volts. The generation voltage will be 2300. This work will be completed early in 1914 and the cost will be about $2,500,000.

Financial Matters Before Vermont Public Service Commission.—Authority to increase its capital stock by $41,250, to be sold only at par, has been granted to the Passumpsic Telephone Company by the Vermont Public Service Commission. The proceeds will be used to purchase the plant and property of the Citizens' Telephone & Telegraph Exchange of St. Johnsbury. The New England Telephone & Telegraph Company is in control. The board has granted the Burlington Traction Company the right to issue bonds to the total of $500,000, bearing interest at the yearly rate of 6 per cent, to be secured by a mortgage on the property of the Burlington company and of the Vergennes Power Company, of Vergennes, Vt. The proceeds of bonds sold to the amount of $200,000 are to be applied in the form of cash to purchase the real estate, water-power rights and plant of the Vergennes Power Company. Of the remainder, $150,000 derived from the sale of bonds is to be used to retire bonds due in 1914 on the Burlington system. The rest of the issue is to be held in the treasury until the further order of the board.

Annual Report of J. G. White & Company, Ltd.—The annual report of J. G. White & Company, Limited, of London, recently presented at the company's thirteenth annual meeting by Lord Arthur Butler, who presided, shows another year of good business. The English company, which is the direct outcome of the successful operations of J. G. White & Company, Incorporated, of New York, in foreign territory, has again this year declared a total dividend of 12 per cent. on its preferred stock and 62 per cent. on its common stock, after which the net earnings for the year have been sufficient to make sbstantial additions to the special reserve and surplus accounts.

Milwaukee Railway & Light to Issue Bonds.—The Milwaukee Electric Railway & Light Company has been authorized to issue $3,000,000 of general and refunding mortgage bonds, to bear interest at the rate of 5 per cent. and to be secured by a refunding mortgage issued to the Bankers Trust Company of New York. The bonds are not to be sold for less than 75 per cent. of par value and the proceeds from the sale are to be used in paying an outstanding indebtedness incurred by reason of additions and extensions made to the property and for making further extensions.

Western Electric's Business in First Half of 1912.—Including returns for June, which were about 10 per cent larger than those in the same month a year ago, the total goods billed out by the Western Electric Company in the first half of its current fiscal year were about 2 per cent larger than the total in the corresponding period of 1911. From the results obtained in the first six months, the company expects that its estimate made earlier in the year that its 1912 business would be approximately the same as the $66,000,000 total in 1911 will be realized.

Financial Condition of New England Power Company of Maine.—A report showing its financial condition on April 1, 1912, has been filed by the New England Power Company of Maine, with the Massachusetts Secretary of State. This is the first statement filed by the company. It shows total assets of $5,300,000 made up of real estate and stocks. The liabilities given are capital stock $5,000,000 and accounts payable $300,000.

A Foreign Aluminum Combination.—According to press despatches, announcement was made at a meeting of the Neuhausen Aluminum Company, the large German aluminum producers, that an aluminum syndicate has been formed abroad which will come into operation next January. It is stated there are several small foreign producers who have not joined the syndicate but are expected to do so before long.

Oberlin (Ohio) Gas & Electric Company Sold.—The Light & Development Company, of St. Louis, a holding company which operates gas and electric properties in various parts of the country, has acquired control of the Oberlin (Ohio) Gas & Electric Company, through purchase of the company's $85,000 second mortgage bonds and all of its common stock.

New Directors for Butte (Mont.) Electric & Power Company.—At the annual meeting of the Butte (Mont.) Electric & Power Company, Eliot Wadsworth and Frederick Strauss, of New York, were elected, succeeding Copley Amory, of New York, and F. L. Ames, of Boston, retiring directors. All officers of the Company were re-elected.

Michigan Telephone Companies to Merge.—Permission to purchase the Home Telephone Company, of Detroit, and its four subsidiaries in Southeastern Michigan has been asked by the Michigan State Telephone Company. It is understood that a purchase price of $3,500,000 has been agreed upon by the two companies.

Hall Signal Reorganization Plan Accepted by Stockholders.—Between 90 and 95 per cent. of the stockholders of the Hall Signal Company have accepted the modified plan of the readjustment committee, details of which were given in these columns July 6, 1912.

REPORTS OF EARNINGS.

FEDERAL LIGHT & TRACTION COMPANY, NEW YORK.

The consolidated statements of earnings of the subsidiaries of the Federal Light & Traction Company, after elimination of inter-company earnings, for the month of May, 1912 and 1911, and for the twelve months ended May 31, 1912 and 1911, compare as follows:

May:	1912.	1911.
Gross	$112,183	$96,014
Operating expenses	68,654	57,562
Net from operation	$43,529	$38,452
Twelve months ended May 31:	1912.	1911.
Gross	$1,335,631	$1,213,026
Operating expenses	768.392	682,348
Net from operation	$567,239	$530,678

The figures for the Trinidad (Col.) Electric Transmission, Railway & Gas Company and the Deming (N. M.) Ice & Electric Company are not included in the above statements.

BELL TELEPHONE SYSTEM IN UNITED STATES.

The earnings reported by the Bell Telephone System in the United States for the five months ended May 31, 1912, including statements of the American Telephone & Telegraph Company and associated holding and operating companies in the United States, not including connected independent or sub-licensee companies, compare with those for the same period of 1911 as is shown in the following statement. All duplications, including interest, dividends and other payments to the American Telephone & Telegraph Company by associated holding and operating companies are excluded.

	1912.	1911.
Gross earnings	$79,788,638	$72,710,093
Expenses:		
Operation	26,031,740	24,687,766
Current maintenance	12,678,768	11,940,888
Depreciation	13,635,102	11,168,376
Taxes	4,165,582	3,669,872
Total expenses	$56,511,192	$51,466,902
Net earnings	$23,277,446	$21,243,191
Deduct interest	5,473,980	5,727,507
Balance net profits	$17,803,466	$15,515,684
Deduct dividends (paid for three months and estimated for two months)	11,955,103	10,479,243
Surplus earnings	$5,848,363	$5,036,441

The unexpended portion of the provision made for depreciation for the first five months of 1912 was $6,226,747, which is not counted as profits but remains as a reserve.

KINGS COUNTY (N. Y.) ELECTRIC LIGHT & POWER COMPANY AND EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN

The combined income statements of the Kings County (N. Y.) Electric Light & Power Company and the Edison Electric Illuminating Company of Brooklyn for the months of June, 1912 and 1911, and for the six months ended June 30, 1912 and 1911, compare as follows:

June.	1912.		1911.	
Gross operating revenue	$398,860			$368,395
Operating expenses excepting taxes and depreciation charges	$179,983		$166.073	
Taxes	34,500		32,500	
Depreciation charges	53,136		42,713	
Total operating expenses	$267,619			$241,286
Net operating revenue	$131,241			$127,109
Non-operating revenue	3,140			6,817
Total net income	$134,381			$133,926
Bond discount written off	1,689			1,689
	$132,692			$132,237
Fixed charges—bond interest	70,547			70,172
P. & L surplus	$62,145			$62,065
Six months ended June 30.	1912.		1911.	
Gross operating revenue	$2,598,855			$2,307,329
Operating expenses excepting taxes and depreciation	$1,067,158		$973,205	
Taxes	206.000		195,000	
Depreciation charges	358,027		272,400	
Total operating expenses	$1,631,184			$1,440,605
Net operating revenue	$967,671			$866,724
Non-operating revenue	25,672			30,508
Total net income	$993,343			$897,232
Bond discount written off	10,135			10,135
	$983.208			$887,097
Fixed charges—bond interest	423,280			385,406
P. & L. surplus	$559,928			$501,691

AMERICAN TELEPHONE & TELEGRAPH COMPANY.

The earnings report of the American Telephone & Telegraph Company for the six months ended June 30, 1912, compares with that for the corresponding period in 1911 as follows:

	1912.	1911.
Earnings:		
Dividends	$11,222,693.69	$10,135,518.35
Interest and other revenue from associated companies	6,071,395.06	5,123,444.10
Telephone traffic (net)	2,826,431.97	2,592,277.99
Real estate	37,037.23	46,326.35
Other sources	170,147.17	306,057.49
Total	$20,327,705.12	$18,203,624.28
Expenses	2,265,502.34	1,782,461.06
Net earnings	$18,062,202.78	$16,421,163.22
Deduct interest	2,761,119.19	2,865,884.70
Balance	$15,301,083.59	$13,555,278.52
Dividends paid	12,635,719.08	10,769,555.67
Balance	$2,665,364.51	$2,785,722.85

PACIFIC POWER & LIGHT COMPANY, PORTLAND, ORE.

The income statements of the Pacific Power & Light Company, of Portland, Ore., for the month of June, 1912, and the twelve months ending June 30, 1912, compare with those for the corresponding periods of the previous year as follows:

June:	1912.	1911.
Gross earnings	$105,059	$95,260
Operating expenses and taxes	49,457	53,240
Net earnings	$55,602	$42,020
Total interest	23,671	29.441
Net income	$31,931	$12,579
Twelve months ended June 30:	1912.	1911.
Gross earnings	$1,208,153	$1,155,526
Operating expenses and taxes	634,048	602,103
Net earnings	$574,105	$553,423
Total interest	333,123	254,773
Net income	$240,982	$298,650
Preferred dividend	118,125	65,625
Second preferred dividend	30,000	.....
Balance	$92,857	$233,025

PRICES IN THE NEW YORK METAL MARKET.

Copper:	July 9		July 16	
Standard:	Bid.	Asked.	Bid.	Asked.
Spot	16.50	17.00	16.75	17.25
July	16.50	17.00	16.75	17.25
August	16.50	17.20	16.87½	17.37½
September	16.50	17.25	16.87½	17.37½
October	16.50	17.00	16.87½	17.37½
London quotation:	£ s d		£ s d	
Standard copper, spot	74 2 6		75 3 9	
Standard copper, futures	75 0 0		75 16 3	
Prime Lake	17.25		17.12½	
Electrolytic	17.00		17.12½	
Casting	16.75		16.90	
Lead	4.75		4.75	
Sheet zinc, f.o.b. smelter	8.75		8.75	
Spelter, spot	7.25		7.25	
Nickel	39.00 to 40.00		40.00 to 41.00	
Aluminum:				
No. 1 pure ingot	21 to 22		21 to 22	
Rods and wire, base	31		31	
Sheets, base	33		33	

OLD METALS.

Heavy copper and wire	16.50	15.00
Brass, heavy	10.25	10.00
Brass, light	8.50	7.75
Lead, heavy	4.25	4.50
Zinc, scrap	5.75	5.75

COPPER EXPORTS IN JULY

Total tons, including July 9, 6,248.....July 16, 14,810

STOCK MARKET PRICES.

	July 10.	July 17.
Allis-Chalmers	1⅜	1⅜*
Allis-Chalmers, pf.	4½	4½*
Amalgamated Copper	81	82½
Amer. Tel. & Tel.	144¾	145⅜
Boston Edison	293*	295*
Commonwealth Edison	139½	137¾
Electric Storage Battery	55	54⅝
General Electric	176¾	178½
Mackay Companies	90	92¼
Mackay Companies, pf.	68⅝	69⅝
Philadelphia Electric	21⅞	21½
Western Union	81½	87⅞
Westinghouse	76	77
Westinghouse, pf.	119*	119*

*Last price quoted.

Personal

Mr. Frank W. Frueauff, of H. L. Doherty & Company, sailed from New York on July 13 for a two months' recreation trip in Europe.

Mr. W. J. Marshall has been appointed commercial manager and **Mr. C. H. Felker** assistant commercial manager of the Toledo Railways and Light Company.

Mr. Walter L. Fairchild, consulting engineer, has become associated with Halbert P. Hall, Inc., New York, and will devote his entire attention to the steel pole industry.

Mr. C. F. Thudium has resigned his position as superintendent of the Municipal Electric Light Plant, Marceline, Mo., to accept a similar position with the Municipal Electric Light & Water Works, Macon, Mo.

Mr. C. Edward Fee, of the Peerless Lamp Works of General Electric Company, sailed for Europe on July 9 to visit his father, United States Consul William T. Fee, at Bremen, Germany. Mr. Fee will return to Warren, Ohio, about Aug. 10.

Mr. T. D. Buckwell, formerly commercial manager for the Toledo Railways and Light Company at Toledo, Ohio, has resigned from that company to become manager of the commercial department of the Peoria Gas & Electric Company at Peoria, Ill.

Mr. H. E. Brandli, superintendent of lighting of the Ottumwa (Iowa) Railway & Light Company, has been appointed manager of the Consumers' Power Company, Minot, N. D., to succeed Mr. Andrew E. Stevens, whose death in an automobile accident was noted in our issue dated July 6.

Mr. R. M. Harding, superintendent of lighting of the Pensacola (Fla.) Electric Company, has been appointed general superintendent of the Columbus (Ga.) Electric Company, which controls and operates the Columbus Railroad, the Columbus Power Company and the Gas Light Company of Columbus.

Mr. Stuart M. Spiller, formerly of the sales department of the Western Electric Company, New York, is now acting as representative of the company in China, succeeding Mr. H. D. B. Moore. In making the trip to Shanghai Mr. Spiller visited London, Antwerp, Paris and Berlin in the interest of the company.

Mr. Arthur C. F. Keleher, assistant sales manager of the Nelite Works of the General Electric Company, has resigned his position and on Sept. 1 will join the sales force in the motor truck department of the Foss-Hughes Company of Philadelphia. Mr. Keleher is a statesman-at-large of the Rejuvenated Sons of Jove.

Mr. H. B. Bryans, who for the past three years has been engineer for the Fulton County Gas & Electric Company, Gloversville, N. Y., has assumed the position of chief assistant to the inspector of tests at the home office of the United Gas Improvement Company, Philadelphia, Pa. Mr. Bryans has been succeeded by Mr. Louis C. Smith.

Mr. John F. Wessel, New York, has been appointed general manager of the Mahoning & Shenango Railway & Light Company, Youngstown, Ohio. Mr. Wessel, who is an electrical engineering graduate of the Massachusetts Institute of Technology, has been identified with electric lighting and railway undertakings for many years, having served for a time as electrical engineer for the Lynchburg (Va.) Traction & Light Company.

Mr. Chas. F. Gray, formerly superintendent of construction for the Canadian Westinghouse Company, and chief erection engineer in charge of the installation of the company's apparatus for the city of Winnipeg's municipal hydroelectric system, has opened a consulting electrical engineering office in the Empress Block, Winnipeg. Mr. Gray had had fifteen years' experience in America, covering a large and varied assortment of engineering and construction work in many of Canada's hydroelectric developments, as well as in several of the large central stations in New York. In addition to this work he had experience on the electrification of the underground tubes in London, England.

Dr. Herbert E. Ives, long identified with illuminating research work, has severed his connection with the physical laboratory of the National Electric Lamp Association to become physicist in the research laboratory of the United Gas Improvement Company, Philadelphia. Dr. Ives was born in Philadelphia on July 31, 1882, the son of Frederick E. Ives, inventor of the half-tone engraving process and three-color photography, recent recipient of the Rumford medal. He was educated in the Philadelphia public schools, the University College School, London, the Rugby Lower School, Rugby, England, the University of Pennsylvania (B. S. 1905), and Johns Hopkins University (Fellow in Physics 1906-8, Ph. D. 1908). He was associated with the Ives Kromskop Company, Philadelphia from 1898 to 1902, assistant and assistant physicist at the Bureau of Standards, Washington, during 1908 and 1909, physicist in the physical laboratory of the National Electric Lamp Association, Cleveland, from 1909 to 1912, and now is physicist for the United Gas Improvement Company, Philadelphia, as noted above. The scientific labors of Dr. Ives have been devoted chiefly to investigations of the production, measurement and utilization of light. Among his scientific contributions have been articles and papers dealing with improvements in diffraction process of color photography; experimental study of Lippmann color photography; photographic phenomena bearing upon the dispersion of light in space; color measurements of illuminants and problems relating to color measurements. He originated the method of estimating "daylight efficiency" of illuminants, which led to the practical production of artificial daylight in the so-called "Tungstolier true-tint" apparatus. He devised a test object for visual acuity measurements and an eye testing device composed of crossed gratings whereby a uniform change in size of detail is produced. He conducted a series of studies in photometry of lights of different color, recently concluded, which established the superior advantages of the flicker photometer for this kind of measurement. He made a study of the firefly, establishing by photographic and phosphor-photographic methods the limited spectral extent of its light and its high luminous efficiency. His studies have included the phenomena of phosphorescence and luminous efficiency. As a result of his studies and his work in heterochromatic photometry, he proposed as a rational standard of light flux one watt of radiation of maximum possible luminous efficiency. He devised various pieces of photometric apparatus, including special neutral-tint screens, a variable neutral-tint absorption screen, a form of spectrophotometer, and lately a watts-per-candle meter for incandescent lamps, whereby lamps may be rated directly for a certain efficiency. Dr. Ives is a member of the American Association for the Advancement of Science, the American Physical Society and the Illuminating Engineering Society (vice-president 1911-12), and a corresponding member London Illuminating Engineering Society.

Obituary

Prof. Jules Henri Poincaré, better known as Henri Poincairé, mathematician and physicist, died in Paris suddenly on July 17 of an embolism. He was born on April 29, 1855. In 1879 he was mining engineer at Versoul, in 1881 he was appointed master of conferences, faculty of science at Paris, and he became professor of natural philosophy 1886 and was professor of mathematics and astronomy at the Sorbonne at the time of his death.

Mr. Stewart S. Neff, long identified with electric railway undertakings, died on July 13, at Atlantic City. Mr. Neff, who was born in Cincinnati, Oct. 24, 1859, graduated from Rensselaer Polytechnic Institute in 1878 and engaged in steam railway work for 17 years. In 1895 he took charge of the "Loop" at Chicago. In 1900 he entered the service of the Boston Elevated Railway as consulting engineer. Upon leaving Boston he was appointed consulting engineer of the Brooklyn Rapid Transit Company, which post he resigned to become general manager of the Mexico City Tramway. More recently he had been general superintendent of the Atlantic City & Shore Railroad, Atlantic City, N. J., and president of the Interstate Engineering & Supply Company, Philadelphia, Pa.

Construction

BIRMINGHAM, ALA.—Extensions and improvements will be made to the system of the Birmingham Ry., Lt. & Pwr. Co., and will include the installation of a 10,000-kw steam turbine, conduit construction, placing all wires in underground conduits in the business district, extension of the lighting system into North Birmingham and extensions to railway system. Ford, Bacon & Davis, New Orleans, La., have charge of the plant.

DOTHAN, ALA.—Bids will be received by the city of Dothan until Aug. 5 for water works and electrical machinery, construction of power house and reinforced concrete reservoir and chimney 8 ft. x 150 ft.; chimney builder to furnish plans. The equipment will consist of two 300-hp steam boilers, one 350-kw generator set, including engne to run condensing with all auxiliaries and cooling tower, switchboard with all instruments and electrical-driven air compressor. Plans and specifications may be obtained on application to the city clerk. W. F. Thornton, Birmingham, is consulting engineer.

KELVIN, ARIZ.—Plans are being prepared by the Kelvin Sultana Mining Co. for the installation of an electric power plant to supply electricity for operating the machinery in its mines. Neil McMillan is superintendent.

MIAMI, ARIZ.—The Secretary of the Interior has authorized the Reclamation Service to execute a contract with the Inspiration Consol. Copper Co. whereby the government agrees to furnish the copper company at its pumping stations and works near Wheatfields and Miami surplus power generated at Roosevelt dam and other points on the Salt River irrigation project. Under the terms of the contract the government is to deliver electrical energy at 40,000 volts, three phase, 25 cycle, not to exceed a maximum load at any time of 11,000 kw in case the Miami Copper Co. is admitted to participation in use of said energy, and not to exceed a maximum of 8000 kw in case the Miama Copper Co. is not admitted, for which the company is to pay 7.5 mills per kw-hour.

PHOENIX, ARIZ.—The Mountain States Tel. & Teleg. Co. has purchased the plant and holdings of the Arizona Tel. & Teleg. Co. Extensive improvements and additions will be made to the system.

ASHDOWN, ARK.—Nagel & Peterson, Muskogee, Okla., are preparing plans for the construction of an electric-light plant for the city, bids for which will soon be asked for.

GRAVETTE, ARK.—Plans are being prepared by Nagel & Peterson, Muskogee. Okla., engineers, for the construction of a municipal electric-light plant, for which $21,000 in bonds have been voted.

BLOOMINGTON, CAL.—Steps have been taken for establishing a lighting district in Bloomington. A proposition for lighting the streets has been submitted by the Southern California Edison Co.

GREENVILLE, CAL.—The Droege Mining Co. has entered into a contract with the Indian Valley El. Lt. & Pwr. Co. whereby the latter will supply electricity to operate the machinery in the Droege mines. A temporary steam plant of 200 hp will be installed as an auxiliary to the hydroelectric power plant, which is to be built on the Feather River at Seneca.

HEMET, CAL.—The Menlo Avenue Wtr. Sup. Co. is planning to install a large electric motor in its pumping plant.

LAKEPORT, CAL.—The Mount Konocti Lt. & Pwr. Co., Lakeport, is planning to extend its transmission lines to Big Valley and Kelseyville. It is also planning to extend the lines to Highland Springs at the same time. It is proposed to install a temporary steam plant in Kelseyville to furnish the service until the plant on Kelsey Creek is completed. J. L. Davis is manager.

LOS ANGELES, CAL.—The Board of Public Works is receiving bids on 34 miles of 250,000 C.M. stranded copper cable. The equivalent in aluminum may be substituted.

LOS ANGELES, CAL.—A movement is on foot to form a lighting district consisting of over 47,000 acres, with a view of lighting the Sherman Boulevard its entire length, 16 miles, with ornamental lamps.

LOS ANGELES, CAL.—The Postal Teleg. Co. has applied to the Board of Public Works for a 21-year franchise that will permit the company to install a conduit and pole line system within the city limits.

LOS ANGELES, CAL.—The Southern Pacific Co. has begun work on equipping its stub steam lines in this vicinity for electrical operation. The old Santa Ana-Newport line is now being converted to electric traction and other branches will soon follow.

LOS ANGELES, CAL.—A report has been filed by E. F. Scattergood, chief engineer of the aqueduct power bureau, with Mayor Alexander stating that the discovery of additional watershed streams on Owens River will add 40,000 hp to the 120,000 hp to be developed from the aqueduct itself and may eliminate the necessity of the erection of a steam-driven auxiliary plant.

OROVILLE, CAL.—The Oro El Corpn. is erecting transmission lines from Oroville to Honcut, Central House and Gridley sections, a total distance of about 25 miles, where electricity for pumping water will be distributed by the company. The cost of the work is estimated at about $50,000. The State Railway Commission has granted the Oro El. Corpn. permission to build an additional power plant on Yellow Creek in Plumas County and to erect a transmission line across Sacramento Valley and the upper San Joaquin Valley in Alameda and Contra Costra, Plumas, Butte, Yuba, Sutter, Colusa, Glenn, Yolo, Solano, Sacramento and Calmas Counties.

PASADENA, CAL.—The city of Pasadena has established a purchasing department in connection with its municipal government. The management of this department would like to have on file for reference complete general catalogues of manufacturers and jobbers of all kinds of materials, tools, machinery, office equipment, miscellaneous supplies, etc. For further information address the Purchasing Department, City of Pasadena, Room No. 2, City Hall Annex, Pasadena.

RIVERSIDE, CAL.—The Pacific El. Ry Co. has authorized surveys made for an electric railway between Riverside and Colton, a distance of about 10 miles.

SAN BERNARDINO, CAL.—The Interstate Tel. Co., a subsidiary of the Southern Sierras Pwr. Co., has completed its telephone line between San Bernardino and Bishop, and will now erect a telephone exchange in Victorville, about 35 miles from San Bernardino.

SAN FRANCISCO, CAL.—The Board of Supervisers has adopted a resolution directing the Board of Works to submit plans and estimates of the cost for extensions of the Geary Street railway from Kearny Street to Market Street opposite Sansome Street and from Thirty-third Avenue to the beach. Plans are also being considered for the extension of the municipal railway down Market Street to the ferry.

SAN FRANCISCO, CAL.—The Pacific Gas & El. Co. has been granted permission by the State Railroad Commission to construct two hydroelectric power plants on Bear River, in Placer County, and to erect a transmission line from the plant through Placer, Nevada, Yuba, Sutter, Yolo and Solano Counties to a point near Crockett, on San Francisco Bay. The initial installation will include four 10,000-kw generators, which later will be increased to 100,000 kw.

SAN LUIS OBISPO, CAL.—The County Supervisors have awarded a franchise to Walter Gould to construct and operate an electric railway over certain roads in the county for a period of 50 years. The franchise also carries the privilege to erect and maintain transmission lines for the distribution of electricity.

SANTA BARBARA, CAL.—The San Luis Obispo County Supervisors have sold the Coalinga Wtr. & Lt. Co., Coalinga, a franchise to erect transmission lines along the public highways for $250.

SANTA ROSA, CAL.—Arrangements are being made by the Great Western Pwr. Co. for the construction of a substation in Santa Rosa.

WOODLAND, CAL.—The railway of the Sacramento & Woodland Ry. Co. has been completed to Woodland. Further extensions to the road will be made.

DENVER, COL.—Plans are being considered by Mayor Arnold and Auditor James F. Markey for utilizing the electric-light plant in the Auditorium to furnish electricity for lamps and motors for the court house and city hall. The city electrician has been instructed to make a report on the feasibility of erecting wires from the plant to the buildings and whether the plant is capable of furnishing the service.

NORWICH, CONN.—Work has commenced on the construction of a new substation near Mastuxetbrook, on the Pleasant View extension, for the Norwich & Westerly Ry. Co.

TAKOMA PARK, D. C.—The Town Council of Takoma Park, Md., has authorized the Mayor to enter into a contract with the Potomac El. Pwr. Co., Washington, D. C., for lighting the town. Under the terms of the contract the company is to install the system as soon as possible and to erect 100 incandescent electric lamps of 40 cp, for which the town agrees to pay $1,500 per year for the first 100 lamps and $15 each for each additional lamp.

WASHINGTON, D. C.—The Washington Ry. & El. Co. is planning to build a new railway to Cleveland Park and Tennallytown.

WASHINGTON, D. C.—An American consul writes that a leading business man in a foreign country, who expects to attend a congress to be held shortly in the United States, is in the market for an electric power plant with sufficient output to illuminate a town with a population of 7000; also six automobiles capable of carrying from 12 to 20 passengers each; also bottle cleaning and filling devices. For further information address No. 9148, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

CLAXTON, GA.—Sealed bids will be received by the Mayor and Board of Aldermen until July 25 for furnishing material for the proposed electric-light plant and water-works system as follows: For approximately 130 tons of 8-in. and 6-in. cast-iron pipe and 4 tons of special castings, 16 fire hydrants, 15 valves and 11 valve boxes, tank and tower, erected, two horizontal tubular boilers, feed-water heater and pump, two 750,000-gal. pumps, two air-compressors and receiver, one 60-kw. alternating-current generator with three-panel switchboard, one high-speed automatic engine, steam, air and hydraulic connections in plant, tungsten street-lamp regulator, lamps and line material, including transformers. Bids will be received on the whole or any part of the above. Plans and specifications may be seen at the office of the city clerk and the H. S. Jaudon Engineering Co., engineers, at Savannah and Atlanta, Ga. Specifications may be obtained by addressing the engineers at Box 582, Savannah.

CORDELLE, GA.—Application will be made to the State Legislature for an amendment to the present city charter authorizing the city to issue bonds to the amount of $50,000 for the establishment of a municipal electric-light plant. It is proposed to install an electric plant in connection with the water-works system.

MARIETTE, GA.—The City Council has entered into a contract with the Georgia Ry. & Pwr. Co., which is now erecting a transmission line through Cobb County, for electricity to operate the municipal electric system. The municipal electric plant will be held in readiness for use in emergencies. L. B. Robeson is a member of the Water and Light Board.

ROCHELLE, GA.—The installation of a municipal electric-light plant is under consideration.

LEWISTON, IDAHO.—The Inland Tel. & Teleg. Co. is planning to erect telephone lines between Spokane, Wash., and Lewiston, a distance of about 90 miles.

NAMPA, IDAHO.—Work will be started at once on the extension of the Idaho Traction Company's railway between Caldwell and Roswell, a distance of 14 miles.

NEZPERCE, IDAHO.—Extensive improvements are contemplated by the Nezperce Co-operative Tel. Co., which will involve an expenditure of about $10,000 and include the erection of a telephone line from Lewiston to Nezperce and Grangeville, a distance of about 90 miles.

OROFINO, IDAHO.—Negotiations have been closed whereby the property and holdings of the Orofino El. Co. will be taken over by the Lewis County El. Co. and will be operated in connection with the latter company's plant.

ALTON, ILL.—The City Council has granted the Alton, Jacksonville & Peoria Ry. Co. a franchise to erect a transmission line on Market Street.

BLANDISVILLE, ILL.—The Board of Trustees would like to receive propositions from reliable parties for a franchise to install and operate an electric-light plant in Blandisville.

CULLOM, ILL.—It is reported that F. A. Ortman, owner of the local electric-light plant, has announced that he will discontinue the electric-light service in this village after Aug. 1.

DANVILLE, ILL.—John A. Shafer, of Indianapolis, Ind., is reported to have agreed to finance and construct an interurban railway between Crawfordsville, Ind., and Danville, via Kingman.

EDWARDSVILLE, ILL.—Judge W. E. Hadley, in the Madison County Circuit Court, has authorized the receiver of the Alton, Jacksonville & Peoria Ry. Co. to issue receiver's certificates not to exceed $150,000 for the completion of the railway between Godfrey and Jerseyville. Power for operating the proposed road will be secured from the Alton Gas & El. Co. Frank L. Butler, Alton, is receiver.

GIRARD, ILL.—A movement is reported to be under way to dispose of the municipal electric-light plant and to have the streets lighted by a private company. The proposition will be submitted to a vote.

MATHERSVILLE, ILL.—The plant of the Continental Brick Co., located near Mathersville, is being equipped for electric motor drive. Electricity for operating the plant will be supplied by the Rock Island Southern Ry. Co., Rock Island.

MILLEDGEVILLE, ILL.—Application has been made to the Council by L. E. Butler, of the Sterling Gas & El. Co., Sterling, for a 25-year franchise to install and operate an electric-light plant here.

OAKLAND, ILL.—The City Council has entered into a contract with Marshall E. Sampsell, of Paris, Ill., to furnish electricity for lighting the streets of the village and to operate the pumping station of the water works system.

RAPIDS CITY, ILL.—The Village Board has appropriated $1,000 for the installation of street lamps. Power for maintaining the street-lighting system will be furnished by the People's Pwr. Co., Rock Island.

RUSHVILLE, ILL.—The local electric-light plant, owned by the Rushville El. Co., is reported to have been sold to the Middle West Utilities Co., of Chicago.

SPRINGFIELD, ILL.—A decision has been handed down by Judge James A. Creighton in the Sangamon County Circuit Court stating that Fourth Street cannot be legally held as part of the park and boulevard system because it is a business thoroughfare. This street already is equipped with ornamental lamps. The city officials are considering furnishing electricity from the municipal water works station for maintaining the lamps if an arrangement can be made with the property owners. Temporary arrangements have been made with the Springfield Lt., Ht. & Pwr. Co. for lighting the thoroughfare. If the equipment cannot be purchased from the electric company the city may purchase new arc lamps.

WEST LEBANON, ILL.—The Cadwallader Tel. Co. has absorbed 11 independent telephone exchanges, which are located in Williamsport, West Lebanon, Marshfield, Ambia, Judyville, State Line, Pence, Rossville and Tab.

BLUFFTON, IND.—An ordinance favoring the sale of the municipal electric-light plant has been passed by the City Council.

HIGHLAND, IND.—Bids will be received by the Highland Wtr. & Pwr. Co. for the erection and equipment of a power plant. Andrew L. Renier and Joseph J. Munster are among the directors.

DAVIS CITY, IA.—At an election held recently the proposition to grant a franchise to the Herald Pub. Co., of Lamoni, to install and operate an electric system was carried. Work will begin at once on installation of the plant.

DOW CITY, IA.—Plans are being prepared by Bruce & Standevin, Bee Bldg., Omaha, Neb., for the installation of an electric-light system, to cost about $5,000.

FORT MADISON, IA.—Plans are being considered for the installation of an ornamental street-lighting system here.

LEHIGH, IA.—The question of issuing bonds to the amount of $20,000 for the installation of a municipal electric-light plant and water works system is under consideration. R. A. DuBois is city clerk.

LINEVILLE, IA.—An election will be called about Aug. 1 to vote on the proposition to issue $15,000 in bonds for the installation of an electric-light plant.

MT. VERNON, IA.—Arrangements are being made by the Wapsie Pwr. Co. for the erection of a transmission line from Springville through Paralta, thence to Lisbon, where it will connect with the Mount Vernon line. From Lisbon a line will extend east to Stanwood.

PERRY, IA.—The plant of the Perry El. Lt., Pwr. & Htg. Co. has been taken over by a syndicate, represented by George A. Huffman, of Des Moines. The purchase price was $90,000. Many improvements will be made by the new owners.

POMEROY, IA.—The installation of an electric-light plant here is under consideration.

ROLFE, IA.—The Northern Lt., Ht. & Pwr. Co., Humboldt, has submitted three propositions to supply electricity for lamps and motors in Rolfe as follows: (1) If granted a franchise and a street-lighting contract for ten years the company agrees to install and maintain a plant here. (2) The Humboldt company offers to erect a transmission line to Rolfe and sell energy to a local company that would build a substation and erect the local distributing system. (3) That a local company be organized to build the transmission line and the local distributing system, purchasing electrical energy from the Humboldt company.

STRATFORD, IA.—The Boone Pwr. & El. Co., Boone, is contemplating extending its transmission lines to this city.

TOLEDO, IA.—The plant and holdings of the Tama & Toledo El. Ry. & Lt. Co. have been purchased by Cedar Rapids capitalists, which also control the Marshalltown Lt., Pwr. & Ry. Co., of Marshalltown. It is understood that the local plant will be dismantled and power furnished from the Marshalltown plant for the local system.

WALCOTT, IA.—The Town Council has called a special election to be held Aug. 19 to vote on the proposition to erect a transmission line from Blue Grass to Walcott to supply electricity for lamps and motors. Energy is to be furnished from the Davenport and Muscatine to be delivered over the high-tension line to be erected from the line of the Davenport-Muscatine Interurban Ry. Co. The proposed line will be about 6½ miles long and will cost about $25,000. The town of Walcott has contracted for thirty 100-watt tungsten lamps for street lighting. Electrical service will be supplied to the farmers along the line between Blue Grass and Walcott. H. C. Blackwell, of Davenport, superintendent of the People's Lt. Co., has charge of preliminary arrangements.

WOODBINE, IA.—A special election has been called for Aug. 6 to vote on the proposition to grant a franchise to the Iowa-Nebraska Public Service Co., Omaha, Neb., to install and operate an electric plant here.

COFFEYVILLE, KAN.—The Union Trac. Co. has awarded the contract for the construction of its proposed railway from Coffeyville to Parsons, a distance of 11 miles, to F. Edwards, of Parsons.

GARNETT, KAN.—The plant of the Garnett El. Co. was recently destroyed by fire, causing a loss of about $50,000.

MANHATTAN, KAN.—The plant and holdings of the Manhattan Ice, Lt. & Pwr. Co. has been purchased by John F. Vail, Pueblo, Col., for $100,000.

SENECA, KAN.—The City Council has closed contracts with the City Councils of Oneida and Axtell for furnishing electricity to those cities from the municipal electric-light plant in this city. The city of Oneida voted $6,000 in bonds for installing a distributing system and Axtell $10,000.

TOPEKA, KAN.—The property owners on East Fourth Street, who petitioned the city commissioners for the installation of an ornamental street-lighting system, the cost not to exceed $2 per abutting ft., have agreed to a higher cost limit.

CORYDON, KY.—An election will be called in September to vote on the proposition to issue $10,000 in bonds, the proceeds to be used to construct a municipal electric-light plant.

LEXINGTON, KY.—The Lexington Utilities Co. has purchased the franchise for erecting transmission lines for the distribution of electricity over a number of the turnpikes of the country.

LOUISVILLE, KY.—The Kentucky El. Co. has secured the contract for furnishing electricity for lamps and motors for the federal building in Louisville.

LOUISVILLE, KY.—The Louisville Ltg. Co. has been awarded the contract for furnishing electricity for two new office buildings here, the Inter-Southern Life, an 18-story building, at Fifth and Jefferson Streets, and the Starks Building, at Fourth and Walnut Streets, 15 stories high.

LOUISVILLE, KY.—Investigations are being made by a syndicate of real estate men of Louisville, represented by James H. Button, to determine whether power for commercial purposes could be developed at Louisville by means of the falls of the Ohio River. The Ambursen

Hydraulic Constr. Co., Boston, Mass., has been engaged to compile data on the subject.

SHREVEPORT, LA.—The Shreveport Trac. Co. has been granted a franchise to construct and operate two street railway lines, one to extend to and through the suburb of Allendale and the other to the City Park.

WOODLAWN, MAINE.—The St. Croix Paper Co. has commenced work on the construction of a large hydroelectric power plant at the Grand Falls of the St. Croix River to furnish power for its paper mills here. The dam will be of concrete, between 800 and 900 ft. long. The power house will be erected about 1000 ft. below the dam. A 23,000-volt transmission line will deliver the power to the mill.

CENTERVILLE, MD.—Arrangements are being made by the Town Council for the construction of an electric-light, heat and power plant to furnish electrical service in Centerville and parts of Queen Anne's County. It is proposed to issue bonds to the amount of $20,000 to pay for same.

FREDERICK, MD.—The Frederick & Hagerstown Pwr. Co. has been granted a franchise by the County Commissioners to erect a transmission line from its plant at Security to the plant of the Frederick R. R. Co. at Thurmont. The power company has also secured the right-of-way over the Washington County roads.

KENSINGTON, MD.—The Town Council has awarded a contract to the Potomac Pwr. Co., Washington, D. C., for lighting the streets by electricity. The contract calls for 60 lamps of 40 cp.

BOSTON, MASS.—Bids will be received by the Trustees of the Boston State Hospital, Morton Street, Boston, Mass., until July 25 for an engine, electrical apparatus, steam piping, and electric wiring for the Boston State Hospital. Separate bids are to be submitted for each item. Plans and specifications may be obtained at the office of Hollis, French and Allen Hubbard, 88 Pearl Street, Boston, engineers.

SPRINGFIELD, MASS.—Plans have been submitted by the street-lighting committee of the City Council to a committee of the Park Board for ornamental lamps for Park Square. The plans provide for the erection of 30 ornamental standards carrying five-lamp clusters.

STONEHAM, MASS.—The Board of Trade will soon take up the question of having all telephone, electric-light and other wires placed under ground.

WATERTOWN, MASS.—Bids will be received at the Watertown Arsenal, Watertown, Mass., until Aug. 12 for construction and equipment of power plant. Proposal forms, plans and specification will be furnished on application to the commanding officer of Watertown Arsenal.

DETROIT, MICH.—The Michigan State Tel. Co. has petitioned the state for permission to purchase the property of the Home Tel. Co., of Detroit, and its four subsidiaries in Southeastern Michigan. The purchase price is said to be $3,500,000.

MARQUETTE, MICH.—The Cleveland Cliffs Iron Co. is preparing to build a large storage dam at Forty-Acre Falls to supplement its large Marquette range water-power development.

CHOKIO, MINN.—The Chokio-Southwestern Tel. Co. contemplates the construction of about 15 miles of telephone lines.

GARY, MINN.—The Gary Telephone Co. is planning to erect new lines and rebuild old lines.

MADISON, MINN.—Bonds to the amount of $50,000 have been voted for improvements to the municipal electric-light plant and installing water works system.

MINNEAPOLIS, MINN.—Steps have been taken by the South Side Commercial Club for the installation of ornamental street lamps on Washington Avenue from Thirteenth Avenue S and on Cedar Street to Fifth Street, the cost of which is estimated at $5,000.

MINNEAPOLIS, MINN.—The Consumers Pwr. Co., controlled by H. M. Byllesby & Co., Chicago, Ill., who recently purchased the control of the Minneapolis General El. Co., has filed a trust deed at Stillwater for $5,000,000 to secure a second mortgage on its properties in Minnesota and the Dakotas in favor of the Standard Trust Co. of New York. This move is preliminary to the combining of the Consumers Pwr. Co. and the Minneapolis General El. Co. under one management and in one operating system.

OLIVIA, MINN.—All bids received June 10 for an oil engine for the municipal electric-light plant were rejected and new bids are being asked for a 100-hp gas engine and a 75-hp gas producer.

WATERVILLE, MINN.—The Consumer's Pwr. Co., Cannon Falls, is planning to erect a distributing system here. The substation will be 30 ft. x 60 ft., two stories high, of concrete construction.

JACKSON, MISS.—Sealed bids will be received by the Trustees of the Mississippi Insane Hospital until Aug. 6 for furnishing and erecting an ice plant of from 15 to 20 tons daily capacity, and for furnishing a steam engine and a 75-kw direct-current generator, direct connected, and a double-acting deep-well pump with a capacity of 250 gal. per minute against a head of 300 ft., together with a direct-current motor to drive same. Specifications may be secured on application to Hamilton Johnson, mechanical engineer, 418 High Street, Jackson, Miss.

NATCHEZ, MISS.—At a recent meeting of the City Council it was recommended that the committee on lights and water confer with the Municipal Water Works Commission for the purpose of considering the question of installing an electric generating plant in connection with the water-works system.

PONTOTOC, MISS.—The local electric light plant, owned by J. W. Bell, has been purchased by L. E. Price, of Utica, Miss. A new franchise has been granted to Mr. Price, who will make improvements to the system. An ice plant will also be installed in connection with the electric plant.

VICKSBURG, MISS.—The property of the Vicksburg Ry. & Ltg. Co. has been purchased by I. C. Elston and W. B. Walker, of Chicago. It is understood that the new owners will make extensive improvements. For further information address I. C. Elston, Jr., New York Life Bldg., Chicago.

FARMINGTON, MO.—The property of the St. Francois County R. R. Co. has been purchased by the Mississippi River & Bonne Terre R. R. Co., operating a steam railroad. The St. Francois company operates an electric railway from Flat River to De Lassus, a distance of 10 miles. The new owners contemplate several improvements to the system.

FREDERICKTOWN, MO.—A special election has been called to vote on the proposition to issue $35,000 in bonds for the construction of an electric-light plant.

PALMYRA, MO.—The proposition to issue $6,000 in bonds for extensions to the municipal electric-light plant will be submitted to a vote.

ST. CHARLES, MO.—The question of granting a franchise to the Mississippi River Pwr. Distribution Co., a subsidiary of the Mississippi River Pwr. Co., is under consideration by the City Council and the Citizens' Improvement Association. The proposition will probably be submitted to a vote.

ST. JOSEPH, MO.—Surveys have been completed by the St. Joseph Ry., Lt., Ht. & Pwr. Co. for the proposed extension of its Twenty-second Street line.

ST. LOUIS, MO.—Right of way has been secured through St. Louis County from Florissant to St. Louis for the new transmission line of the Mississippi River Pwr. & Distributing Co.

BUTTE, MONT.—Plans have been submitted to the City Council for the installation of an ornamental street-lighting system in the business district. The cost of the installation of the system is estimated at $37,175 and the maintenance at $17,721 per year. The plans call for luminous arc lamps.

HELENA, MONT.—Plans are being considered for the installation of electroliers in the business district.

AINSWORTH, NEB.—The plant of the Ainsworth El. Lt. & Pwr. Co. has been put out of commission owing to the breaking away of its dam on Plum Creek.

CURTIS, NEB.—Bids will be received by the City of Curtis until July 30 for the construction of an electric-light plant, to cost about $8,000. P. B. Cole, Cambridge, Neb., is engineer in charge; F. E. Dillman is clerk.

DESHLER, NEB.—The Deshler Lt. & Pwr. Co. is planning to install an electric plant here, work on which will begin soon. The proposed plant will supply electricity for manufacturing plants in Deshler and for lamps and motors to farmers and neighboring towns.

OMAHA, NEB.—The Nebraska Bell Tel. Co. has purchased the automatic plant of the Independent Telephone Co. in Omaha for $905,000, at a receiver's sale.

OMAHA, NEB.—The Omaha & Council Bluffs St. Ry. Co. contemplates extensions to the Fortieth and Cummings-West Farnum Street line and the North Twenty-fourth Street line from Fort Street to Miller Park.

WINNEMUCCA, NEV.—The County Commissioners have called a special election to be held on Aug. 15 for the purpose of voting on the proposition to issue $180,000 in bonds for the purchase of the property of the Winnemucca Wtr., Lt. & Pwr. Co. to be owned and operated by the municipality. Of the proceeds $172,000 will be used to purchase the plant and $8,000 for improvements to the system.

NEWARK, N. J.—Bids will be received at the office of the Board of Education, Newark, until July 23 for furnishing power transmission machinery for the Central C. and M. T. High School, in accordance with specifications on file in the office of the Department of Supplies. R. D. Argue is secretary.

PATERSON, N. J.—Rights of way from the New York and North Jersey Rapid Tran. Co. in Paterson, it is reported, have been purchased by Thomas P. McKenna, 111 Broadway, New York. Work will soon be started on the proposed electric railway from New York to Paterson, the cost of which is estimated at about $18,000,000.

RAHWAY, N. J.—The report submitted to the Board of Water Commissioners by Commissioner Ransome recommends the installation of a municipal electric-lighting plant in connection with the water-works system in the near future.

ALBANY, N. Y.—The New York Tel. Co. has filed a notice with the Public Service Commission that it has purchased the property and holdings of the Onondaga Independent Tel. Co. for $700,000; the Albany Home Tel. Co. in Greene County, at $50,500; the Baldwinville Tel. Co., for $13,100; the Newburgh Home Tel. Co., for $11,800; the Home Tel. Co., of Frewsburg, Chautauqua County, for $8,000, and the Deposit Home Tel. Co., for $6,100.

ALDEN, N. Y.—The Depew & Lancaster Lt., Pwr. & Conduit Co., Lancaster, has petitioned the Public Service Commission for approval of exercise of franchise granted by the town of Alden.

CHARLOTTE, N. Y.—The Rochester Ry. & Lt. Co. has submitted a proposition to the village authorities asking for a franchise to supply electricity and gas here, offering to supply electrical service at a much less cost than now furnished by the municipal electric plant. If granted a franchise the company agrees to purchase the municipal plant at $12,500. A special election will be held July 27 to submit the proposition to a vote.

CICERO, N. Y.—Arrangements are being made by Frederick J. Auburn to install an electric-light plant to supply electricity for lighting residences and business places in this village. The village is not incorporated and street-lighting is not involved in the project.

FULLERVILLE, N. Y.—Anson A. Potter and J. Finch, of Gouverner, have purchased what is known as the Clark water power in Fullerville, where they will erect a hydroelectric plant to develop about 2000 hp. A company will be organized under the name of the Fullerville Pwr. Co. to operate the plant. The company will supply electricity to the Ontario Talc Co. and other manufacturing plants in this vicinity.

JOHNSTOWN, N. Y.—The Public Service Commission has granted the Little Falls & Johnstown R. R. Co. a certificate of public convenience and necessity for its proposed electric railway from Johnstown to Little Falls, via St. Johnsville, with a branch from the village of St. Johnsville through Nelliston and Fort Plain to Canajoharie. The main line will be about 28 miles long and the branch 8 miles. The cost, including equipment, is estimated at $1,773,970.

KATONAH, N. Y.—The Katonah Ltg. Co. has been granted permission by the Public Service Commission to execute a mortgage to secure payment on bonds to the amount of $125,000. The company has been authorized to issue $75,000 in bonds immediately, the proceeds to be used for the payment of construction on its new steam plant and extensions to South Salem, Poundridge and Bedford, and to discharge its lawful capital obligations.

LOCK BERLIN, N. Y.—Propositions have been submitted to the municipal authorities for installing an electric-lighting system in Lock Berlin by the Rochester, Syracuse & Eastern R. R. Co., Syracuse, and the Central New York Gas & El. Co., Seneca Falls.

NEWFANE, N. Y.—The Newfane El. Co. has applied to the Public Service Commission for permission to exercise franchises granted by the town of Newfane.

NEW YORK, N. Y.—Plans have been approved by the Public Service Commission for the section of the subway running from Church Street via Vesey to Broadway and Park Place. Bids for construction of this section will be opened July 31.

NEW YORK, N. Y.—Bids will be received by Patrick A. Whitney, commissioner of Department of Correction, 148 East Twentieth Street, New York, until July 23 for furnishing material and labor for the installation of a new feeder, conduit, panel board and branch circuit system at the city prison buildings on Center Street, Manhattan. Blank forms and further information may be obtained at the above office.

NEW YORK, N. Y.—A meeting of the stockholders of the Manhattan Bridge Three-Cent Fare Co. has been called for July 24 for the purpose of voting on the proposition to increase the capital stock of the company from $50,000 to $1,000,000. Mayor Gaynor has signed the franchise giving the company the right to operate cars across the Manhattan Bridge. Work on construction of the railway will be started in the near future.

NORTH SYRACUSE, N. Y.—A company has been organized in North Syracuse to furnish electricity to private consumers. Power for the system will be furnished by the Syracuse & South Bay R. R. Co.

OLEAN, N. Y.—The Public Service Commission has authorized the Olean El. Lt. & Pwr. Co. to use $76,929 derived from the sale of bonds, heretofore authorized, for the construction of a steam power plant.

RAY BROOK, N. Y.—Sealed proposals will be received by Martin E. McClary, president of Board of Trustees, Ray Brook, N. Y., until July 23 for one 50-kw, direct-current dynamo and engine, direct-connected, for the New York State Hospital for Incipient Tuberculosis, at Ray Brook. Drawings and specifications may be consulted and blank forms of proposals obtained at the hospital and at the office of Herman W. Hoefer, state architect, Albany, N. Y.

ROCHESTER, N. Y.—Property owners on Clinton Avenue are considering the question of a new street-lighting system on that street.

WATERTOWN, N. Y.—The Watertown Lt. & Pwr. Co. is planning to construct a flume on the north side of Black River from 300 ft. to 400 ft. long and about 20 ft. wide. The new flume will develop about 150 hp, which will provide power for Charles W. Sloat & Son.

SMITHFIELD, N. C.—Proposals will be received by the Mayor and Board of Aldermen until July 31 for construction of combined waterworks system and electric-light plant; also sewerage system. The work will consist of fireproof building, return tubular boilers, generator and engine and lighting system, steam and electric pumps, mechanical filter, coagulating and clear water basins, pole lines and about 3½ miles of 6 and 8-in. cast-iron water pipe, laying with hydrants and valves. Plans and specifications are on file at the office of James A. Wellons, Mayor, and at the office of Gilbert C. White, Charlotte, N. C., engineer. A full set of blueprints will be furnished by the engineer upon payment of $5.

DEVILS LAKE, N. D.—The City Council has granted a franchise to F. E. Carson, Fargo, to install and operate an electric-light plant, water, gas and telephone system in Devils Lake. A company will be organized under the name of the Western Devel. Co. to operate the system. The cost of the electric plant is estimated at $60,000.

FARGO, N. D.—The electric-light plant and laundry building at Ashelman's resort was recently destroyed by fire, causing a loss of about $5,000. A new engine has been ordered for the plant.

COLUMBUS, OHIO.—Proposals for furnishing material and construction of building for substation of the municipal electric-light plant and water works system on Chittenden Avenue, Columbus, will be received by Samuel A. Kinnear, director of public service, until July 29, plans and specifications for which are on file at the office of the director of public service, in custody of the superintendent of the municipal electric-light plant, city hall, where copies may be obtained.

COSHOCTON, OHIO.—The Coshocton Lt. & Htg. Co. is extending its transmission lines to the Morgan Mines to furnish electricity at the mines.

NEWARK, OHIO.—The Public Service Commission has authorized the Columbus, Newark & Zanesville El. Ry. Co. to isssue $250,000 in bonds, the proceeds to be used for extension of its line in Newark to Granville Street and to build a new station.

OBERLIN, OHIO.—The property of the Oberlin Gas & El. Co. has been purchased by the Lt. & Devel. Co., of St. Louis, Mo., for $85,000.

PORTSMOUTH, OHIO.—The Portsmouth Street Ry. & Lt. Co. is contemplating extending its Sciotoville traction line to Hanging Rock this summer.

SIDNEY, OHIO.—The Farmer's Tel. Co. has applied to the Public Utilities Commission for permission to issue $11,840 in capital stock and $10,000 in bonds.

WILLOUGHBY, OHIO.—Plans are being considered by the Cleveland, Painesville & Eastern R. R. Co. for the construction of an electric railway from Ashtabula to Conneaut, a distance of 14 miles.

WILMINGTON, OHIO.—All bids submitted for lighting the streets, public grounds, etc., bids for which were opened July 9, have been rejected. Frank Babb is clerk.

YOUNGSTOWN, OHIO.—The Mahoning & Shenango Ry. & Lt. Co. is contemplating the construction of an electric railway from Mahoning Avenue through Steel Street to the Ohio Works. Application will soon be made to the Council for a franchise to build the road.

MUSKOGEE, OKLA.—Plans are being prepared by the W. H. Rosecrans Engineering Co., Chicago Exchange Bldg., Chicago, Ill., for construction of new railway shop buildings for the Missouri, Oklahoma & Gulf R. R. Co., to be located at Muskogee. The equipment will be electrically driven. The cost of the plant is estimated at about $400,000.

WARRENTON, ORE.—Application has been made by George A. Robinson for a franchise to construct a car line in this city.

HAUTO, PA.—The Lehigh Navigation El. Co. has contracted with the General El. Co. for three 10,000-kw, 11,000-volt turbo-generator units for its proposed plant at Hauto. This will be initial installation of the power house, which will provide for 100,000 hp. Culm from the anthracite region will be used as fuel.

KANE, PA.—Arrangements are being made for the construction of an electric railway to connect Kane and Mount Jewett, a distance of about 12 miles, work on which will begin in the near future. A local system will be built in Kane, which will be extended to James City, a distance of 3 miles. J. C. Bell and W. M. Rohn, Jamestown, N. Y., are interested.

MORRISTOWN, PA.—At a joint meeting of the Electrical Commission, the finance committee and the watch and lamp committee of the Town Council it was decided to recommend the purchase of the Wyoming mills property and the appurtenant water rights on the Schuylkill River at the foot of Swede and De Kalb Streets, for a municipal electric-light plant. The mill property consists of a four-story stone building with turbine water wheels and an auxiliary steam plant, which is the property of the borough as part of its municipal plant.

NORTH EAST, PA.—The North East El. Lt. & Pwr. Co. is planning to erect 17 miles or more of 6600-volt transmission line and will probably award contract for the work, the company furnishing the material. R. O. Bronson is superintendent.

PHILADELPHIA, PA.—The Philadelphia Rapid Tran. Co. has commenced work on construction of a large power house at the corner of Fifteenth and Tucker Streets, to cost about $30,000.

PHILADELPHIA, PA.—A permit has been granted for the erection of an office building, to cost $75,000, for the Philadelphia Suburban Gas & El. Co., at the corner of West Washington Square and Locust Street.

PINE GROVE, PA.—The Borough Council has passed the ordinance granting a franchise to the F. X. Troxell El. Lt. Co. to install and operate an electric-light plant here.

PITTSBURGH, PA.—A special meeting of the stockholders of the Pennsylvania Lt. & Pwr. Co. has been called for Sept. 10, to vote on the proposition to increase the capital stock of the company from $1,000,000 to $2,000,000 and to authorize a bond issue of $5,000,000. Until recently the operations of the company were restricted to the North Side. It was recently granted a franchise to operate in other parts of the city.

TRUMBAUERSVILLE, PA.—The Borough Council has authorized

the president and chief burgess to enter into a contract with the Trumbauersville El. Lt. & Pwr. Co. to light the streets of the borough with electricity.

CORREGIDOR ISLAND, P. I.—The contract for electrical equipment for central power plant for Corregidor Island, P. I., bids for which were opened by Captain A. E. Waldron, New London, June 15, has been awarded to the Ridgeway Dynamo & Engine Co., Ridgeway, Pa., for $41,160. The equipment includes three 469-kva turbine generators with condensers complete, one 156-kva turbine generator complete, two 300-kw synchronous converters with transformers and one automatic voltage regulator.

CHERAW, S. C.—Papers have been filed by the Yadkin Pwr. Co., Raleigh, N. C., with the Secretary of State giving it the right to do business in the state of South Carolina. Charles E. Johnson, Raleigh, N. C., is president.

MITCHELL, S. D.—The City Council has appointed a committee to make investigations in regard to standards for the proposed cluster-lamp lighting proposition and to ask bids for same to be submitted at the next meeting of the Council.

GREENVILLE, TENN.—H. Reaves, Greenville, is reported to be in the market for one 10-kw, three-phase, 60-cycle, 240-volt, alaternating-current generator with exciter; 10-kw, 110-volt, direct-current generator, instruments, switchboards and switches and two 20-hp vertical automatic engines.

McMINNVILLE, TENN.—The Ottawa Wtr. & Pwr. Co. has increased its capital stock from $50,000 to $75,000. It is understood that improvements will be made to the plant

PARKSVILLE, TENN.—The Eastern Tennessee Pwr. Co., which is building a second plant on the Ocoee River, near Parksville, has awarded a contract to the Converse Bridge Co., Chattanooga, Tenn., for the installation of 500 tons of structural steel to be used in the flumes which are now being built.

ST. ELMO, TENN.—The Business League of St. Elmo is considering the question of installing an electric-light system here. The plant will probably be operated by the Chattanooga Ry. & Lt. Co.

VAUGHTSVILLE, TENN.—W. W. Worley, Vaughtsville, would like to receive prices on water wheel, 50 hp under head; 45-kw generator, 10 miles No. 6 bare copper wire, lightning arresters, transformers, etc.

BATESVILLE, TEX.—The Batesville Tel. Co. is erecting an extension to its long-distance telephone system between Batesville and Pearsall and is planning to make other improvements to its plant.

BROWNWOOD, TEX.—The plant and holdings of the Brownwood Gas & El. Co. has been purchased by the Texas Lt. & Pwr. Co. for $100,000. The new owners, it is said, will build an electric street railway system here.

HILLSBORO, TEX.—The Texas Lt. & Pwr. Co., it is reported, will make extensions and improvements to its local plant at a cost of about $30,000.

TOOELE, UTAH.—The control of the property of the Clark El. Pwr. Co. has been purchased by W. A. Clark, for $90,000. The plant will be synchronized with the plant owned by Mr. Clark at Ophir. Mr. Clark is also contemplating the installation of a hydroelectric plant on South Willow Creek, about 8 miles from Grantsville. E. W. Clark, Ophir, is president and manager of the company.

BURLINGTON, VT.—The American Gas Co., which controls the Burlington Lt. & Pwr. Co., is reported to have purchased the power at Bolton and at Middlesex. It is understood that the company proposes to connect this power with its system at Essex Junction, and will consolidate the three, and furnish power in Barre and intermediate towns.

PASSUMPSIC, VT.—The Public Service Commission has granted the Passumpsic Tel. Co. authority to increase its capital stock by $41,250, the proceeds to be used to purchase the plant and property of the Citizens' Tel. & Teleg. Co., of St. Johnsbury.

BEDFORD CITY, VA.—L. S. Randolph, of Virginia Polytechnic Institute, Blacksburg, Va., has been engaged by the City to examine and make recommendations on the condition of the hydroelectric power plant owned by Bedford City.

BUENA VISTA, VA.—The Clifton Forge Public Service Corpn., Clifton Forge, has purchased the property of the Rockbridge Pwr. Corpn., consisting of two hydroelectric plants, one located at Buena Vista and the other at Lexington. The Clifton Forge Co. owns and operates a steam plant in Clifton Forge furnishing electricity for lamps and motors to the city and the railway shops, and is erecting a transmission line to Covington. The erection of a transmission line connecting the four cities is contemplated.

COLVILLE, WASH.—The Farmers' Tel. Co. is planning to erect a telephone line from Colville to the Little Pend Oreille Lake, a distance of about 25 miles.

SEATTLE, WASH.—The Board of Public Works has awarded the contract for the construction of division A of the municipal street railway from Thirteenth Avenue west and Nickerson Street to Third Avenue and Stuart Street to the John Constr. Co. H. R. Dimock is city engineer.

ARDEN, W. VA.—The Midland Coal & Coke Co., Phillippi, is reported to have purchased the property of the Tygarts River Coal Co. and of several smaller companies on branch of the Baltimore & Ohio R. R., and contemplates the construction of a central power station to supply all its mines with power.

GRAFTON, W. VA.—Sealed proposals will be received by W. C. Hanway, city clerk, until July 29 for construction and furnishing machinery for the proposed municipal electric-light and water-works system, plans and specifications for which may be obtained at the office of the city clerk or at the office of Riggs & Sherman, The Nasby, Toledo, Ohio, engineers.

LA CROSSE, WIS.—The Wisconsin Railroad Commission has authorized the La Crosse Tel. Co. to issue $20,000 in capital stock, the proceeds to be used for the installation of a new switchboard, underground construction and the installation of new telephones.

MANITOWOC, WIS.—A movement has been inaugurated for the purchase by the city of the plant of the Manitowoc El. Lt. Co. A resolution has been introduced into the City Council to submit the question to a special vote at the general election to be held Nov. 5. Mayor Stolze is interested.

MILWAUKEE, WIS.—The Milwaukee El. Ry. & Lt. Co. has received authority from the Wisconsin Railroad Commission to isssue $3,000,000 in bonds, to be sold for not less than 75 per cent of par value and the proceeds to be used to pay outstanding indebtedness incurred by additions and extensions to its property and for making further extensions.

NEW HOLSTEIN, WIS.—The installation of a municipal electric-light plant is under consideration, for which bonds were recently voted.

VANCOUVER, B. C., CAN.—The British Columbia El. Ry. Co. has been instructed by the City Council of West Vancouver to start work immediately on the construction of its electric railway in that city or the franchise granted some time ago would be annulled.

VANCOUVER, B. C., CAN.—The International Ry. & Devel. Co., organized to build several electric railways through lower British Columbia, is planning to construct a large dam across the Fraser River to develop about 100,000 electrical hp. The construction of an electric railway from New Westminster to Ladner, a distance of 12 miles, and another line from Ladner to Vancouver, 20 miles long, is under consideration.

COLLINGWOOD, ONT., CAN.—The ratepayers have voted in favor of securing power from the Hydro-Electric Commission. The Council is authorized to contract for 700 hp at $34 per hp and also to appropriate $22,000 for extensions and improvements to the present electric plant.

COLLINGWOOD, ONT., CAN.—Tenders have been asked for the construction of the transmission line for the Hydro-Electric Power Commission to Collingwood, where the ratepayers have entered into a contract with the commission. The proposed line will be 65 miles long and will cost about $198,000. The line will also serve Midland and Penetang, Coldwater and Barrie will be connected with the line in the near future, and probably Stayner and Elmvale.

HAMILTON, ONT., CAN.—Tenders will be received by George H. Lees, Mayor, until July 24 for furnishing the city of Hamilton with four synchronous motor units for direct connection to turbine pumps, with switching apparatus and accessories, complete, for the high-level and mountain pumping systems; also four turbine pumps, each having a capacity of 1,000,600 imperial gallons per 24 hours, for direct connection to synchronous motors. Specifications can be seen at the office of the city engineer, where form of tender can be obtained. S. H. Kent is city clerk.

HULL, QUE., CAN.—The E. B. Eddy Co. is planning a large hydroelectric power development to supply electricity to operate the machinery in its factory. The plant will have an output of from 12,500 to 15,000 hp. William Kennedy, Jr., of Montreal, is consulting engineer.

GRENFELL, SASK., CAN.—Plans are being prepared for the construction of a telephone building for the Rural Tel. Co., to cost about $15,000. The company will extend its lines throughout the county. Eli G. Vesey, Grenfell, is president.

New Industrial Companies

THE ART CRAFT FIXTURE COMPANY, of Newark, N. J., has been incorporated with a capital stock of $50,000 by C. M. Hickman, F. J. Holmberg, De Witt Van Note and F. C. Jaeger, of Newark, N. J. The company proposes to manufacture lighting fixtures.

THE AUSTRICH ARC LAMP COMPANY, of New York, N. Y., has been incorporated by John C. Tomlinson, Jr., Bruno Rothschild and Max Austrich, all of New York, N. Y. The company is capitalized at $20,000 and proposes to manufacture arc lamps, etc.

THE FULLER ELECTRIC COMPANY, of Lynn, Mass., has been chartered with a capital stock of $5,000 to do a general electrical business and dealing in all kinds of electric appliances and apparatus. Elbert N. Fuller, 57 Dearborn Avenue, Lynn, is president and treasurer.

THE LITTLE WONDER LIGHT COMPANY, of Terre Haute, Ind., has been incorporated with a capital stock of $10,000 for the purpose of manufacturing and selling all kinds of lamps, apparatus, equipment and supplies and to take over the manufacturing plant of Charles Van Slyke, of Terre Haute. The incorporators are: Charles P. Walker and Herbert R. Shrie.

THE SANTA CRUZ ELECTRICAL SUPPLY COMPANY, of Santa Cruz, Cal., has been incorporated with a capital stock of $6,000 by C. H. Fredson, C. E. Glaine and M. L. Fredson.

THE STATIONARY & MARINE MOTOR & SUPPLY COMPANY, of New York, N. Y., has been granted a charter with a capital stock of $50,000 for the purpose of manufacturing machinery, etc. The incorporators are: T. Lillis, Grassy Point; T. B. Taylor, Port Washington and F. W. Knipscher, Boonton, N. J.

THE WESTERN UTILITIES CORPORATION, of Augusta, Maine, has been incorporated with a capital stock of $500,000 for the purpose of constructing and operating electric, gas, water and other works. R. S. Buzzell, president, and L. J. Colyman, of Augusta, Maine.

New Incorporations

JACKSONVILLE, FLA.—The Okeechobee Co. has been incorporated with a capital stock of $200,000 for the purpose of building electric plants. The incorporators are: J. R. Parrott, W. F. Coachman, W. J. Kelly, D. R. McNeill and others.

HIGHLAND, IND.—The Highland Wtr., Lt. & Pwr. Co. has filed articles of incorporation with a capital stock of $2,000 for the purpose of building and operating a plant to supply electricity for lamps and motors and water in Highland and community. The directors are Andrew L. Renier, Joseph J. Munster and Frank Berwanger.

BOWLING GREEN, KY.—The Barren River Pwr. Co. has been organized with a capital stock of $10,000 for the purpose of constructing a hydroelectric plant at Brown's Lock, near Bowling Green. Electricity generated at the plant will be used to operate machinery in stone quarries in that district. John Oman, George Oman and W. B. Gaines are incorporators, and are also interested in the stone quarries.

GLENCOE, MINN.—The Central Minnesota Lt. & Pwr. Co. has been granted a charter to generate and distribute electricity and gas for lighting and power purposes. The incorporators are: B. F. Allen, Jay Greaves, C. M. Tifft, of Glencoe, and H. B. Rutledge, of San Francisco. The company proposes to establish central plants to furnish gas and electrical service.

CLEVELAND, OHIO.—The Caxton Pwr. Co. has been incorporated by Harry W. Black, C. F. Wolcott, Edmond Griere, A. B. Lapham and W. Weidenthal. The company is capitalized at $10,000 and proposes to operate electric-light power and steam plants.

TOLEDO, OHIO.—The Toledo & Eastern Trac. Co. has been incorporated with a capital stock of $40,000 by R. S. Holbrook, William S. Holbrook, H. H. Whitney, Joseph Steiner and Arthur J. Barton. The company proposes to build an interurban railway to connect Curtice and Bono.

WEST SALEM, OHIO.—The West Salem Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000 to supply electricity for lamps, heat and motors. The incorporators are: John W. Jackson, Frank F. Jackson, Emma Jackson, John I. Good and John M. Good.

HUGO, OKLA.—The Bomford El. Co. has been incorporated with a capital stock of $3,000 by Wright Bomford, G. Earl Shaffer and John D. Bomford.

PERRY, OKLA.—The Arbuckle Canyon Pwr. Co. has been incorporated by George A. Masters, R. E. Wade and Charles R. Bostick, all of Perry. The company is capitalized at $10,000.

GRANDVIEW, ORE.—The Metolius Irrigation & Pwr. Co. has been incorporated by a group of local business men.

PORTLAND, ORE.—The Seaside Lt. & Pwr. Co. has been incorporated with a capital stock of $50,000. The directors are: A. Welch, William Pollman and A. Prichard. The principal office will be located in Portland.

BALDWIN, PA.—The Baldwin El. Co. has been granted a charter to operate an electric system in Baldwin Township. The company is capitalized at $5,000 and the incorporators are: C. B. Mehard and Joseph A. Jenkins, Pittsburgh, and E. N. Barber, Crafton. The office of the company is located in Mount Oliver.

BUTLER, PA.—A charter has been granted to the Summit Lt. Co. to operate in Summit Township and to the Mars Lt. Co. to operate in Mars Township. Each company is capitalized at $5,000 and the incorporators are: C. R. Bartley and W. H. Shrawder, Pittsburgh, and F. M. Weston, Swissvale, Pa.

CONSHOHOCKEN, PA.—The Conshohocken Pwr. Co. has been incorporated with a capital stock of $10,000. The directors are: S. Leonard Kent, Jr., Philadelphia, treasurer; Samuel L. Kent, Lansdowne; Walter L. Rogers, Riverton, N. J.; John D Murphy, Philadelphia, and Adolph Ahrens, 3rd., Philadelphia.

ELIZABETH, PA.—The Elizabeth Township El. Co. has been granted a charter with a capital stock of $5,000. The incorporators are: W. H. Larimer, Wilkinsburg; F. J. Taylor, Munhall, and W. R. Hammer, Pittsburgh. The office of the company is located at Pittsburgh.

HARRISBURG, PA.—Charters have been granted to the Mars Lt. Co. and the Summit Lt. Co. by the State Department. Each company is capitalized at $5,000 and the directors are: F. M Weston, Swissvale, treasurer; Charles R. Bartley, Butler, and W. H. Shrawder, Pittsburgh.

Trade Publications

STORAGE BATTERIES.—The Electric Storage Battery Company, of Philadelphia, Pa., has issued Bulletin 136 illustrating and describing in detail storage battery railway cars.

PUMPS.—Horizontal duplex piston pumps operated by directly connected vertical gasoline engines are described and illustrated in Folder D 171 of the Deane Steam Pump Co., 115 Broadway, New York.

TURBINES.—A four-page folder illustrates and describes the turbines manufactured by the Trump Manufacturing Company, Springfield, Ohio. It contains also a table giving power and speed of the standard type.

BUSHINGS.—The American Bushing Company, 69 West Washington street, Chicago, Ill., is mailing two samples of their bushings attached to a card on which is given some brief information with respect to these bushings.

HEATING DEVICES.—In poster size and make-up the Pacific Electric Heating Company, Ontario, Cal., is exploiting its various "Hotpoint" electrical devices, flatirons, toasters, percolators and other similar contrivances.

ELECTRIC FANS.—A timely bulletin, No. 25, is being mailed by the Diehl Manufacturing Company, of Elizabethport, N. J. It contains cuts and descriptions of various types of fans, and general specifications for direct-current ceiling fans.

BINDING POSTS.—The Fahnestock Electric Company, 129 Patchen avenue, Brooklyn, has issued a catalogue on its spring binding posts. It shows most of the standard sizes and shapes and illustrates some special work that has been done.

TURBINES.—Bulletin 619, of the Platt Iron Works Company, Dayton, Ohio, is devoted exclusively to the description of its cylinder gate turbine. It gives a description and illustrations of this wheel, various tables of dimensions and power tables.

ELECTRICITY IN THE SHOE AND LEATHER INDUSTRY forms the subject of Bulletin 4931 of the General Electric Company, Schenectady, N. Y. It contains illustrations and descriptions of various installations in the shoe and leather industry.

ELECTRIC MOTORS.—Booklet No. 89 of the Robbins & Myers Co., of Springfield, Ohio. The policy of the company, its equipment for manufacturing, the quality of its products, and complete descriptions and numerous illustrations are included in this booklet.

VALVES.—Catalogue S of the Nelson Valve Company, Philadelphia, shows a complete line of steel valves and fittings, arranged for easy reference by the architect. The line indicates an assortment for filling almost every requirement of the modern high-pressure plant.

BALL BEARINGS.—The Hess-Bright Manufacturing Company, of Philadelphia, Pa., has issued a booklet on ball bearings in wood-working machinery. Some good illustrations and diagrams show the application of ball bearings to various classes of wood-working machinery.

Business Notes

PASS & SEYMOUR, INC., Solvay, N. Y., have opened an office in the Rialto Building, San Francisco, Cal., in charge of Mr. W. Brewster Hall.

NELITE WORKS OF THE GENERAL ELECTRIC COMPANY.—A type of reflector, claimed to be much more efficient than the present polyphase line will soon be placed on the market by the Nelite Works of the General Electric Company. "Xtraficiency" is the name selected for the newcomer.

CATALOGUES WANTED. The City of Pasadena, Cal., has recently created a Municipal Purchasing Department. The municipal ownership of certain public utilities has made it desirable to establish such a department. Complete general catalogues of materials, tools, machinery, office equipment and miscellaneous supplies are desired.

CARBO STEEL POST COMPANY.—Mr. W. L. Fairchild has associated himself with Halbert P. Hill., Inc., of 30 Church St., New York, and will devote his entire attention to the sales and engineering department of the Carbo Steel Post Company, Chicago. Mr. Fairchild will make his headquarters at the New York office, but will be in charge of the above mentioned department of the company.

THE HART MANUFACTURING COMPANY, whose English branch with headquarters in London has been for nine years under the management of Mr. William Crichton, has built up a large business in "Diamond H" switches. Their rapidly increasing business has made it necessary to consider the removal of their present offices in Victoria Street to new quarters which will provide space for carrying larger stocks and permit workshop facilities for assembling work.

THE KIESELGUHR COMPANY OF AMERICA.—Mr. T. M. Caven, designer of electric heating appliances, has resigned as manager of the Bon Ami Electric Company, Milwaukee, to become manager of the electrical department of the Kieselguhr Company of America, with an office at 1633 Monadnock Building, Chicago. Kieselguhr is a natural mineral product, consisting mainly of silica, and is used for a variety of purposes, including heat and electrical insulation. Mr. Caven is interested in pointing out the possibilities of kieselguhr in electric-furnace and electric-oven work.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 9, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,031,698. SIGNALING SYSTEM; C. D. Ehret, Philadelphia, Pa. App. filed May 24, 1907. Electro-magnetic impulses are sent, stored, and periodically discharged.

1,031,707. AUTOMATIC FIRE-ALARM; M. Gibson, Davisville, Ontario, Canada. App. filed Oct. 30, 1911. Thermometric device.

1,031,708. ELECTRIC CURRENT REGULATOR; J. S. Goodwin, Stamford Hill, London, England. App. filed Jan. 6, 1912. Synchronous interrupter with a plurality of movable contacts.

1,031,710. PROCESS OF CONNECTING FILAMENTS AND FEED WIRES FOR ELECTRIC INCANDESCENT LAMPS; F. Hanaman, Budapest, Austria-Hungary. App. filed Aug. 28, 1909. Decomposition of the solder is prevented by a stream of gas.

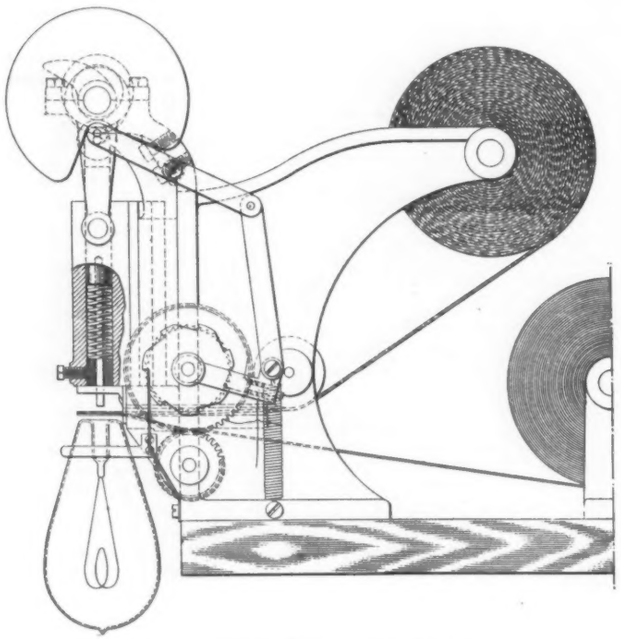
1,031,716. MAKING ELECTRICALLY CONDUCTING JOINTS IN METALLIC-FILAMENT INCANDESCENT ELECTRIC LAMPS; A. C. Hyde, London, England. App. filed Mar. 4, 1910. A solder is formed of iron powder, collodion solution and iron oxide.

1,031,743. ALTERNATING-CURRENT BRAKE-MAGNET APPARATUS; A. Sundh, Yonkers, N. Y. App. filed Oct. 9, 1905. Combination dashpot and magnet.

1,031,752. TELEGRAPH TRANSMITTER; R. S. Welty, Sudbrook Park, Md. App. filed July 19, 1911. Adjusted from high to low speed and vice versa by moving a weight.

1,031,768. SWITCH MECHANISM; E. G. K. Anderson, Chicago, Ill. App. filed Aug. 10, 1909. Push button electric light snap switch.

1,031,770. LAMP-MANUFACTURING MACHINE; G. W. Beadle, East Orange, N. J. App. filed July 19, 1909. For cutting and inserting spacing felt and labels into bulb stems.



1,031,770—Lamp Manufacturing Machine.

1,031,787. RHEOSTAT; F. D. Hallock, Pittsburgh, Pa. App. filed Dec. 21, 1910. Resilient support for a non-conducting tube and surrounding coil.

1,031,789. CIRCUIT INTERRUPTER; F. W. Harris, Wilkinsburg, Pa. App. filed Mar. 9, 1908. A plurality of independent enclosing casings for the different switch elements.

1,301,795. LIGHTNING ARRESTER; R. P. Jackson, Swissvale, Pa. App. filed Oct. 8, 1910. Arcing member and magnetic blow-out.

1,031,796. LIGHTNING ARRESTER; R. P. Jackson and H. M. Scheibe, Swissvale and Wilkinsburg, Pa. App. filed Oct. 8, 1910. Horn-gap type with adjustable air gap.

1,031,802. HYSTERESIS STARTING DEVICE FOR INDUCTION MOTORS; B. McCollum, Washington, D. C. App. filed Dec. 12, 1911. Squirrel-cage rotor with surrounding magnetic rings.

1,031,812. SEAM-WELDING APPARATUS; R. F. Nailler, Elyria, Ohio. App. filed Sept. 25, 1911. Electric heating and hammering for tube welding.

1,031,847. THERMOSTAT; J. S. Harley, Minneapolis, Minn. App. filed May 22, 1911. Releasable mercury section in a closed circuit.

1,031,848. ELECTRIC SIGNALING SYSTEM; J. S. Harley, Minneapolis, Minn. App. filed May 22, 1911. Normally closed thermostat circuit and a normally open signal circuit.

1,031,849. ELECTRIC SWITCHING MECHANISM; J. S. Harley, Minneapolis, Minn. App. filed May 22, 1911. For use in a system embodying the two previous patents.

1,031,863. SIGN FLASHER; S. A. Palmer, San Diego, Cal. App. filed July 7, 1911. Annular arrangement of circuit contacts with a rotatable closer.

1,031,874. DEVICE FOR AUTOMATICALLY CLOSING COCKS AND THE LIKE; K. V. Rotzov, Malmö, Sweden. App. filed June 30, 1910. Condensation of steam produced shuts off the heat supply.

1,031,890. STARTER FOR VAPOR APPARATUS; P. H. Thomas, East Orange, N. J. App. filed May 25, 1904. The normal surface tension of the mercury is reduced.

1,031,893. CENTRIFUGAL SWITCH; J. A. VOLK, JR., South Norwalk, Conn. App. filed Oct. 11, 1911. Contacts and mercury in a rotatable casing.

1,031,900. MANUFACTURE OF HOLLOW BODIES FROM QUARTZ; F. W. Burckhardt, Biebrich, Germany. App. filed Dec. 23, 1911. The silica is fused around a resistance core at about 2000 deg. C.

1,031,931. STARTER FOR VAPOR ELECTRIC APPARATUS; P. C. Hewitt, New York, N. Y. App. filed May 27, 1904. The container is tilted for starting.

1,031,947. TELEPHONE RECEIVER; C. T. Mason, Sumter, S. C. App. filed Sept. 12, 1910. Insulating parts with metal casing.

1,031,975. MINE INSULATOR; F. A. Warren, Canon City, Col. App. filed July 24, 1911. Tubular wire holder in two parts.

1,031,976. ATTACHMENT OF INCANDESCENT ELECTRIC LAMPS; O. Weber, Reinickendorf, Germany. App. filed Sept. 14, 1911. Conical sleeve with spring fingers.

1,032,027. CONNECTION FOR RUNNING ARC LAMPS; W. Schaffer, Berlin, Germany. App. filed Jan. 13, 1910. An electrolytic-cell battery in parallel with a regulating resistance and incandescent lamps are connected in series with the arc lamps.

1,032,030. CIRCUIT CLOSER; G. H. Sloane, Boston, Mass. App. filed May 26, 1908. Operated by a passing trolley.

1,032,033. AUTOMATIC SAFETY DEVICE; G. E. Thurber, Michigan City, Ind. App. filed March 3, 1911. Supplementary track and train circuit with means for automatically cutting off the driving power and applying the brakes.

1,032,102. DANGER SIGNAL FOR ELECTRIC CARS; J. Anderson, Jr., Omaha, Neb. App. filed April 21, 1909. A gong and lamp in a casing.

1,032,108. SELF-WINDING CLOCK; S. S. Besore, Urbana, Ill. App. filed June 22, 1910. Means for making and breaking the circuit.

1,032,133. CONNECTING PLUG; C. L. Hagen, New York, N. Y. App. filed March 9, 1910. Disappearing plug and cable for theater work.

1,032,153. INSULATOR; M. Nemes, Fort Dodge, Iowa. App. filed Dec. 14, 1911. Porcelain with movable clamping hook for line wires.

1,032,158. ELECTRODE FOR SECONDARY GALVANIC CELLS; H. P. R. L. Pörscke and J. A. E. Achenbach, Hamburg, Germany. App. filed May 1, 1911. Impregnated wire mesh corrugated and compressed.

1,032,188. FUSE BLOCK; R. C. Cole, Hartford, Conn. App. filed March 23, 1912. For protecting a meter on both sides and permitting testing.

1,032,203. ELECTRIC GAS LIGHTER; H. D. Grinnell, Pittsfield, Mass. App. filed July 20, 1911. Particularly for acetylene.

1,032,058. JUNCTION BOX; H. R. Gilson, Beaver, Pa. App. filed Oct. 2, 1911. Bendable lugs for metal molding.

1,032,217. APPARATUS FOR THE PRODUCTION OF STEEL; H. Johnson, Sheffield, England. App. filed Nov. 15, 1910. Double-ended portable converter.

1,032,231. TROLLEY HEAD; R. J. Meyers, Florence, Arizona. App. filed Jan. 22, 1912. Laterally projecting replacing spirals.

1,032,246. METHOD OF TREATING CARBON; W. A. Smith, Niagara Falls, N. Y. App. filed April 20, 1911. The material is fed downward past the terminals of the polyphase circuit.

1,032,247. ELECTRODE; W. A. Smith, Niagara Falls, N. Y. App. filed May 29, 1911. Exterior and interior graphite members with intermediate filling of non-graphic carbon.

1,032,248. COMPOSITE ELECTRODE; W. A. Smith, Niagara Falls, N. Y. App. filed June 5, 1911. Graphite and interlocking non-graphitic carbon.

1,032,249. GUTTER BOX; E. W. Snow, Rochester, N. Y. App. filed Oct. 31, 1910. For electric conduit distribution braids.

1,032,250. COMPOSITE ELECTRODE; E. C. Speiden, Niagara Falls, N. Y. App. filed May 17, 1910. A plurality of overlapping prismatic members.

1,032,262. ELECTRIC ARC LAMP; T. E. Adams, Cleveland, Ohio. App. filed Oct. 15, 1908. Regulation of metallic electrode shunt differential type.

1,032,263. ELECTRIC ARC LAMP; T. E. Adams, Cleveland, Ohio. App. filed April 16, 1909. Starting device for metallic electrodes, regulation and collection of deposits.

1,032,267. MEANS FOR TRANSFORMING ELECTRIC ENERGY INTO HEAT; C. O. Bastian, London, England. App. filed Sept. 4, 1909. A quartz tube with a spirally wound internal resistance element.

1,032,295. MEANS FOR PROTECTING PIPES FROM THE INJURIOUS ACTION OF ELECTRIC CURRENTS; G. Politz, Kattowitz, Germany. App. filed April 11, 1911. A gasket is formed of a flexible core with a wire coil for electrically connecting the pipe ends.

1,032,301. ELECTRIC METER; G. A. Scheeffer, Indianapolis, Ind. App. filed Jan. 14, 1910. Depends upon the reduction in reluctance of the armature.

1,032,324. APPARATUS FOR TREATING RHEUMATISM; R. A. Breakfield, Madrid, Iowa. App. filed March 20, 1912. Zinc and copper construction.

1,032,345. RAILWAY BLOCK SYSTEM; W. G. Roome, Los Angeles, Cal. App. filed March 3, 1902. Provides a safety block behind a car in a home and distant system.

1,032,360. TELEPHONE-RECEIVER HOLDER; F. H. Goss, Corapolis, Pa. App. filed Feb. 27, 1912. Adjustable supports for two receivers.

1,032,362. ELECTRIC LOCK LAMP SOCKET; A. J. Kempien, St. Paul, Minn. App. filed Oct 3, 1908. Key mechanism improvement on 738,917.